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Editorial Office :
'Shivalay' 98-A, Somdutt Vihar, Garh Road, Meerut-250 004 (U.P.) INDIA
E-mail: hortfloraspectrum.india@gmail.com; editorhortflora.vku@gmail.com
Mob.: +91-9412833903

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Contents

HortFlora Research Spectrum, 1(1): 1-4 (2012) ISSN : 2250-2823

NATURAL MEDICINAL CHEMISTRY : CURES FROM A "LIVING FOSSIL"

Pooja Sapra Sharma[1] and Rajan Sharma

Eidogen-Sertanty Inc, California, U.S.A.

[1]Ch. S. S. Shandilya (P.G.) College, Machhra, Meerut.

E-mail: poojasapra.sharma@gmail.com

ABSTRACT: Ginkgo (*Ginkgo biloba* L.), is one of the oldest living tree species and its leaves are among the most extensively studied herbs in use today. Nicknamed as "living fossil" by Charles Darwin, *Ginkgo* is over 150 million years old and was thought to be extinct until it was found growing in China in 17th Century. In western world, *Ginkgo* supplements are among the best-selling herbal medications. *Ginkgo* leaves contain two types of chemicals (flavonoids and terpenoids) believed to have potent antioxidant properties. *Ginkgo* has been used in Chinese traditional medicine to treat blood disorders and enhance memory. Scientific studies throughout the years have found evidence that supports these claims. Although not all studies agree, *Ginkgo* may help treat dementia (including Alzheimer's disease) and intermittent claudication, or poor circulation in the legs. It also shows promise for enhancing memory in older adults.

Keywords : *Gingko bilboa, CNS, Alzheimer disease, EGb 761.*

The *Ginkgo* tree (*Ginkgo biloba* L.), is the only surviving member of a family Ginkgoaceae, of trees, that appeared more 150 million years ago, and it is often called a ''living fossil (Major, 8). It is distinct from all other living plants and is often categorized in its own division, Ginkgophyta. *G. biloba* is dioecious, on which, the male and female structures exist on separate trees. *Ginkgo* trees can grow over 35 m high, with the main stem up to 10 m in girth and can reach ages in excess of 1000 years. The tree is characterized by fan-shaped leaves split in the middle, which served as inspiration for the name ''biloba'' meaning two-lobed (Stromgaard, 14).

Although *G. biloba* and other species of the genus were once widespread throughout the world, their range shrank until by two million years ago to a small area of China. For centuries it was thought to be extinct in the wild, but is now known to grow in at least two small areas in Zhejiang province in Eastern China, in the Tian Mu Shan Reserve. However, recent studies indicate high genetic uniformity among *Ginkgo* trees from these areas, arguing against a natural origin of these populations and suggesting that the *Ginkgo* trees in these areas may have been planted and preserved by Chinese monks over a period of about 1,000 years (Shen *et. al.,* 13).

Ginkgos adapt well to the urban environment, tolerating pollution and confined soil spaces. They rarely suffer disease problems, even in urban conditions, and are attacked by few insects. For this reason, and for their general beauty, *Ginkgos* are excellent urban and shade trees, and are widely planted along many streets (Bombardelli *et al.,* 1).

Extreme examples of the Ginkgo's tenacity may be seen in Hiroshima, Japan, where six trees growing between 1–2 km from the 1945 atom bomb explosion were among the few living things in the area to survive the blast. While almost all other plants (and animals) in the area were destroyed, the *Ginkgos,* though charred, survived and were soon healthy again. The trees are alive to this day (http://kwanten.home.xs4all.nl/hiroshima.htm).

Ginkgo leaf is the symbol of the Urasenke school of Japanese tea ceremony. The tree is the national tree of China. *Ginkgos* are also popular subjects for growing as penjing and bonsai; they can be kept artificially small and tended over centuries. Furthermore, the trees are easy to propagate from seed.

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Medicinal Value

The earliest records on the use of *G. biloba* as medicine dates back to 1505 AD, where *G. biloba* treated aging members of the royal court for senility (Dementia when seen in the elderly was called senile dementia or senility) (Drieu and Jaggy, 4). Around 1965, leaf preparations of *G. biloba* were introduced to the Western world by Dr. Willmar Schwabe, and together with Beaufour-Ipsen (now Ipsen), a standardized *G. biloba* extract called EGb 761 was developed (McKenna *et al.,* 9). Many *G. biloba* products have entered the market, and *G. biloba* extract is now among the best-selling herbal medications worldwide. Today over 50 million *G. biloba* trees are grown, particularly in China, France, and South Carolina in the United States, producing approximately 8000 tons of dried leaves each year. In India, *G. biloba* is seen at high altitude in Kumaun Himalaya (Sati and Joshi, 12). Since 2000, according to the current ATC-classification, *G. biloba* special extract is listed in the group of anti-dementia drugs together with cholinesterase inhibitors and memantine (Weinmann *et al.,* 15).

EGb 761 is standardized with respect to the content of terpene trilactones (6%) and flavonoids (24%). The terpene trilactones are the five ginkgolides (ginkgolide A, B, C, J and M) and bilobalide, whereas the flavonoids are mainly flavonol-O-glycosides. EGb 761 contains many other components, including proanthocyanidins (prodelphinidins) and organic acids, particularly ginkgolic acids (anarcardic acids), which have allergenic properties; hence, the content in EGb 761 is limited to 5 ppm (McKenna *et al.,* 9). The ginkgolides are diterpenes with a cage skeleton consisting of six five-membered rings, including three lactones, a tetrahydrofuran ring, and a spiro [4.4] nonane skeleton, and a characteristic tert-butyl group. The ginkgolides vary only in the number and positions of their hydroxyl groups. Bilobalide is also a terpene trilactones with a structure similar to the ginkgolides and is the major single component in EGb 761, comprising about 3% of the total extract, whereas the five ginkgolides take up another 3% (Stromgaard, 14). The structural studies by Nakanishi (10) led to the discovery of the structures of ginkgolides rank among the greatest achievements in natural products research.

In studies of the pharmacological effects of *G. biloba*, particularly on effects in the central nervous system (CNS), EGb 761 has been widely used, and the effects include improvement of cognition, antioxidant effects, increased cerebral blood flow and circulation, modification of neurotransmission, and protection against apoptosis (Ponto *et al.*, 11).

The most extensive clinical studies with EGb 761 have focused on alleviation of Alzheimer's disease (AD). Several clinical studies for using EGb 761 for treatment of dementia and cognitive functions associated with AD, have concluded that EGb 761 have a small but significant effect on objective measures of cognitive function in AD, without significant adverse effects. However, in light of the current lack of treatment for AD patients, EGb 761 could prove useful as an alternative to the currently available treatments (Janssen *et al.,* 6).

Tinnitus is a symptom frequently encountered by ear, nose, and throat practitioners. A causal treatment is rarely possible, and drug and nondrug treatment options are limited. One of the frequently prescribed treatments is *G. biloba* extract. Therefore, randomized, placebo-controlled clinical trials of *G. biloba* extract preparations were searched for and reviewed systematically. There is evidence of efficacy for the standardized extract, EGb 761, in the treatment of tinnitus from three trials in patients in whom tinnitus was the primary complaint (von Boetticher et. al., 16).

Ginkgolide B (GKB) is an anti-inflammatory extract of *G. biloba* and has been used therapeutically. It is a known inhibitor of platelet activating factor (PAF), which is important in the pathogenesis of asthma. Histological studies demonstrated that GKB substantially inhibited OVA-induced eosinophilia in lung tissue and

mucus hyper-secretion by goblet cells in the airway. These results suggest that GKB may be useful for the treatment of asthma and its efficacy is related to suppression of extracellular regulating kinase/ MAPK pathway (Chu *et al.,* 3).

A study carried to investigate the anticancer effects of three analogues of EGb 761 samples on sarcoma 108 (S180)-bearing mice and leukemic 1210 (L1210) cell lines is reported. The study also evaluated the changes of endogeneous antioxidant scavenging enzymes, including superoxide dismutase (SOD), glutathione (GST), lipid peroxidation (LPx), and catalase (CAT), in the blood of the S180-bearing mice. The EGb 761, EGb 761-H (containing mainly flavonoid aglycones and terpene trilactones), and EGb 761-DT-H (containing mainly flavonoid aglycones) samples exhibited cytotoxicity and inhibitory activity with IC50 values of 46.36 ± 2.43 μM, 10.27 ± 0.88 μM, and 14.93 ± 0.73 μM in L1210 cell-based assays, respectively. This resulted in 41.74 %, 60.72 %, and 63.76 % reductions in tumor weight after 10 days of treatment, respectively. It was observed that anticancer activity of EGb 761 can be improved by increasing the concentration of the aglycone form of the flavonoid. Terpene trilactones cannot exert the anticancer effects of flavonoids in vivo. Raising the levels of the free radical scavenger enzymes GST, SOD and CAT may be one of the involved anticancer mechanisms (Feng *et al.,* 7).

Recently, the antibacterial activity of methanol, ethanol, chloroform, and hexane extracts of the leaves of Himalayan *G. biloba* was assessed against five animal and plant pathogenic strains (*Agrobacterium tumefaciens, Bacillus subtilis*, *Escherichia coli, Erwinia chrysanthemi,* and *Xanthomonas phaseoli*) employing disc-diffusion and broth-dilution assays. The methanol extract showed the highest activity (zone of inhibition of 15-21 mm) followed by ethanol (14-19 mm), chloroform (15-20 mm), and hexane (14-19 mm) extracts at 250 μg/mL. A minimum inhibitory concentration (MIC) of 7.8 μg/mL was found for the methanol extract against most of the pathogens tested (Sati and Joshi, 12).

Other than these very specific medicinal uses, the Ginkgo leaf extract has been reported to have neuroprotective, cardioprotective, stress alleviating, and memory enhancing properties and possible effects on geriatric complaints and psychiatric disorders (like winter depression) (Boonkaew and Camper, 2). The extract scavenges excess free radicals and pretreatment with EGb 761 reduces damage by free radicals in patients undergoing coronary bypass surgery. The action of platelet activating factor is antagonized and platelet aggregation is reduced. Blood flow is increased. Release of prostacyclines and nitric oxide was shown to be stimulated (Dubey *et al.,* 5).

Conclusion

The various medicinal uses of Ginkgo leaf extract where it is used either as an antioxidant, antiplatelet, antihypoxic, antiedemic, antibacterial, aphrodisiac, or even as regulator of microcirculatory actions, is believed due to its flavonoid and the terpenoid constituents. Toxicity studies show that the Ginkgo leaf extract is relatively safe for consumption, although a few side effects have been reported, that is, intracerebral hemorrhage, gastrointestinal disturbances, headaches, dizziness, and allergic skin reactions. The use of Ginkgo leaf extract may be promising for treatment of certain conditions, although its long-term use still needs to be evaluated.

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INFLUENCE OF SOIL NUTRIENT STATUS ON YIELD AND QUALITATIVE ATTRIBUTES OF POMEGRANATE (*Punica granatum* L.) AND BER (*Zizyphus mauritiana* LAMK.)

Jitendra Singh and Raj Kumar[1]

College of Horticulture and Forestry, Maharana Pratap University of Agriculture and Technology, Campus Jhalarapatan, Jhalawar-326 023 (Rajasthan).

[1]KVK, Vejhalpur, Panchmahals, Godhra-389 340, Gujarat, India

ABSTRACT: Pomegranate and ber are important fruits find favour especially in arid/ semi-arid areas of tropics all across the globe. Bright sun-shine and light soil offer premium quality in harvest unmatching to the harvest obtained from any where else in the world. However, the share of India in world trade is abysmally low. Quality of the produce matching to international standard is proved as the hard impediment in this regard. It is obvious that the quality of produce depends a lot upon the inherent fertility and productivity of soil. To have an account of all such factors study was undertaken selecting ten representative orchards of pomegranate cv. Ganesh and also of ber cv. Gola of Bikaner district and it was attempted to study the inherent nutrient status of orchards and its impact on physicochemical characteristics of fruits. Soil samples were collected from each orchard from 0-60 cm soil depth. From the investigation it was found that the level of organic carbon, nitrogen, zinc, phosphorus and sulphur was low to medium and potassium content was in medium range in soils of selected sites in orchards in Bikaner district. All soil nutrients were found positively correlated with nutrient status of leaves, fruit yield and qualitative attributes of ber except phosphorous and zinc contents in leaves.

Keywords : *Soil nutrient status, inherent fertility, yield, quality, fruit crops.*

The growth and production of fruit crops depend a lot upon the nutrient status of the soil. This holds especially true for arid region where sandy soils with poor inherent fertility status are predominantly distributed. Working out available nutrient status of the soil become further necessary as in stress environment where sunshine is harsh and humidity is bare minimum, the growth and production of fruit crops become a serious constraint. However, fruit crops being tolerant to hardy climate and amenable to growth even under stress atmospheric conditions, preference is given to grow them. In the study area of Bikaner, sandy soils are major soil type. These soils are characterized by very poor in organic carbon, nitrogen and zinc. Even though, farmers cultivate the fruit crops without taking additional care for available nutrient status of soil. It is also a matter of investigation that how nutrient status affect yield and qualitative attributes, how much relation exist between soil fertility status and yield and qualitative attributes etc.

With such considerations, under present investigation an attempt was made to determine available nutrient status of orchards and their impact on yield and qualitative attributes of fruits of pomegranate cv. Ganesh and also of ber cv. Gola.

MATERIALS AND METHODS

The leaves and soil samples were collected from well grown 10 orchards of the pomegranate cv. Ganesh and also of ber cv. Gola during the month of July to August 2003 and fruit samples were collected as per the maturity of fruits (December –January 2004) from the same orchards of Bikaner district. The soil and leaf samples were air dried, ground and passed through 2 mm sieve and subjected to various analyses. The experiment was laid out in a Completely Randomized Design with 10 treatments and three replications. The amount of organic carbon in soil was determined by Walkely and Black's (23) rapid titration method, available nitrogen by Alkaline Potassium Permagnate method as suggested by Subbiah and

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Asija (20), available phosphorus by Olsen *et al.* (16) and the method as suggested by Metson (13) and available sulphur by extracting the soil using mono calcium phosphate solution, as suggested by Chesnin and Yien (7). Available zinc in soil and plant was determined by DTPA extract estimation using Atomic Absorption Spectrophotometer as suggested by Lindsay and Norwell (12).

Estimation of nitrogen in plant samples was done with wet digestion of plant samples with H_2SO_4 and H_2O_2 by Colorimetric method using Spectronic -20 after development of colour with nessler's reagent as suggested by Snell and Snell (18), phosphorus with the wet digestion of plant samples with triacid mixture using vanado molybodphosphoric acid yellow colour method on spectrophotometer as suggested by Jakson (10), potassium by flame photometer as suggested by Bhargava and Raghupathi (5), available sulphur by digesting the plant leaves with nitric and perchloric acid and the sulphate content was determined turbidititimetrically as $BaSO_4$ by barium chloride gelatin procedure as suggested by Tabatabai and Bremner (21). Ten fruits from each tree were taken randomly at the time of harvesting and weighed and measured for recording fruit length and breadth. Total soluble solids (^oBrix) of selected fruits was observed using Hand Refractometer of 0-30 per cent range (AOAC, 1). Estimation of total sugar content was done by colorimetric method using anthrone reagents as suggested by Dubios *et al.* (8). Acidity was analyzed by diluting the known volume of juice and titrating the same against N/10 NaOH, using phenolphthalein as indicator (AOAC, 1). Pulp percentage was known after weighing the total fruit and deducting the weight of stone. Pulp to stone ratio in case of ber was worked out by dividing pulp weight by stone weight.

RESULTS AND DISCUSSION

Yield and qualitative attributes of pomegr- anate under influence of soil nutrient status

Data related to the electrical conductivity of soils of pomegranate orchards of Bikaner district is presented in Table 1. The mean value of EC was recorded as 0.16 dSm^{-1}. The minimum 0.053 dSm^{-1} and maximum 0.303 dSm^{-1} value of EC were recorded in orchards of Gadwala-II and Husansar –II, respectively. As per the limit given by Muhr *et al.* (14), the soil was categorized into three categories having EC of <1, 1-2 and >3 and dSm^{-1} identifying normal, critical for germination and severely injurious to crops. On the basis of those limits, all samples of pomegranate orchards were in the category of normal soils. It might be due to the application of canal irrigation water and sandy texture of the soils. Also in most of the tube well's the water quality was found good in the study area. The organic carbon is a very important from fertility point view. The maximum 0.21 per cent and minimum 0.10 per cent values of organic carbon were observed in orchards of Nokha and 13 JMD, respectively with the mean value of 0.17 per cent. As per the rating given by Muhr *et al.* (14), the soils having <0.5 per cent organic carbon were categorized under low category. All orchards were found low in organic carbon content of the soils appeared to be mainly due to the sandy nature soil and hot arid climate in the study area. Low organic carbon content, absence of the vegetation and excessive sand drift from the upper soil surface due to the high wind erosion in the area. The results are in complete agreement with the findings of Kameriya (11).

Data as regard to available soil nutrient status of pomegranate orchards as presented in Table 1 indicates the mean value of nitrogen content in soil as 82.41 ha^{-1}. The minimum 60.75 kg ha^{-1} and maximum 102.60 kg ha^{-1} contents of nitrogen were recorded on orchards of Husansar-I and Nokha, respectively. As per the rating given by Tandon (22) the soils having <125 kg ha^{-1} nitrogen were categorized under low category. All the soil samples were found low in available nitrogen content in the study area. The low available nitrogen content in all the soil samples had been due to the absence of natural vegetation, low organic carbon along with other climate and edaphic factors. The results of the present

Table 1: EC, soil organic carbon, available nitrogen, phosphorus, potassium, sulphur and zinc status of different locations of pomegranate cv. Ganesh orchards of Bikaner district.

Treatments (Orchard Location)	EC (dSm ^{1})	Organic Carbon (%)	Nitrogen (Kg ha ^{1})	Phosphorus (Kg ha ^{1})	Potassium (Kg ha ^{1})	Sulphur (Kg ha ^{1})	Zinc (Kg ha ^{1})
Gadwala-I	0.057	0.198	99.00	14.91	137.16	16.00	0.32
Gadwala-II	0.053	0.186	83.70	14.62	136.28	13.50	0.32
Husansar-I	0.077	0.135	60.75	10.92	81.46	9.00	0.23
Husansar-II	0.303	0.207	93.15	25.37	142.21	16.28	0.35
Husansar-III	0.190	0.189	78.30	13.17	123.64	11.27	0.21
Raisar	0.180	0.174	85.05	23.50	136.16	13.75	0.26
13 JMD	0.187	0.100	70.00	19.23	130.00	15.65	0.40
Khichia	0.077	0.153	68.85	11.46	120.00	12.45	0.49
Nokha	0.170	0.210	102.60	10.39	116.33	11.72	0.38
Bikaner	0.190	0.192	87.70	**15.45**	**126.33**	**1**8.00	0.40
Average	0.160	0.170	82.41	15.90	125.02	13.76	0.33
CD(P=0.05)	0.019	0.016	8.22	1.774	6.32	1.530	0.033
CV(%)	4.84	5.47	5.86	6.55	2.97	6.54	5.87

investigation are in accordance with those as reported by Arora *et al.* (3). Data related to available phosphorus are presented in Table 1. The range of it varied from 10.39 to 25.37 kg ha ^{1} with the mean value of 15.90 kg ha ^{1}. The maximum value was recorded in the orchard of Husanasar-II and minimum in the orchard of Nokha. The rating as suggested by Tandon (22), the soils having <10.26 kg ha ^{1} phosphorus have been categorized under low while those having phosphorus 10.26 to 25.85 kg ha ^{1} falls under medium category. All samples were sufficient in phosphorous content. The results of present investigation are similar to those reported by Sacheti and Saxena (17).

The data pertaining to available potassium (Table 1) indicate that the mean value of available potassium content of soil was 125.02 kg ha ^{1}. The minimum 18.46 kg ha ^{1} and maximum 142.21 kg ha ^{1} values of potassium were recorded in the orchards of Husansar-I and Husansar –II, respectively. All soil samples were found medium in available potassium content as per the classification given by Tondon (22). The medium status of potassium may be due to the presence of potassium bearing minerals like muscovite, biotite and feldspar (Ghosh and Hassan, 9).

Table 1 indicates that the average value of available sulphur in soils of these orchards was 13.76 ppm. The minimum 9.00 ppm and maximum 18.00 ppm values of sulphur were recorded in the orchards of Husansar –I and Bikaner, respectively. The above findings are similar to findings of Bhatanagar (6).

It is evident from the data (Table 1) that available zinc content in orchards of study area ranged from 0.21 to 0.53 ppm with the mean value of 0.32 ppm. The maximum and minimum values were recorded in the orchards of Nokha and Khichia, respectively. As per the rating given by Tandon (22), the soils having less than 0.6 ppm of zinc falls under low category. Thus, all the soils of orchards was under low available zinc content. Similar findings were reported by Seth *et al.*(19).

The data related to nutrient content in leaves are presented in Table 2. The maximum content of nitrogen (1.056 per cent), phosphorus (0.276 per

cent), potassium (1.584 per cent), and sulphur (0.211 ppm) were recorded in the leaves of Husansar-II orchard and maximum zinc (23.00 ppm) in the plants of Raisar and 13 JMD orchards. The minimum nitrogen (0.928 per cent) and potassium (1.392 per cent were recorded in plant leaves of orchard of 13 JMD, phosphorus (0.184) in orchards of Bikaner, sulphur (0.188 ppm) in plant leaves in orchard at Raisar and zinc (9.25 ppm) in plant leaves of orchard of Husansar-III. The mean value of nitrogen, phosphorus, potassium, sulphur and zinc were 0.990 per cent, 1.475 per cent, 0.197 ppm and 18.55 ppm, respectively.

It is revealed (Table 3) that the fruit weight varied significaltly in different orchards due to spacially zinc differences and prevailing soil conditions in the study area. The maximum fruit weight (243.30 g) was recorded in the fruit of orchard of Gadwala-I whereas, minimum fruit weight (88.33 g) was recorded in the fruit orchard of Husansar-I. The recorded average fruit weight was 197. 67 g. These findings are similar to that of Bhatanagar (6).

Data related to total soluble solids (TSS) under different locations of orchards of Bikaner district are presented in Table 3. The maximum total soluble solids of 15.99 °Brix and minimum 10.44 °Brix were recorded in the orchard of Husansar-II and Gadwala-II, respectively with the mean value of 13.76 °Brix.

The maximum organic acid (0.457 per cent) was found in juice of fruit of pomegranate at Raisar orchard whereas, minimum acid content (0.300 per cent) was recorded in fruits of Husansar-II orchards with mean value of 0.400 per cent (Table 3). These results are in accordance with the findings of Aggarwal and Chandra (2) who reported total acidity of cv. Ganesh varying from 0.420–0.500 per cent.

Data related to percentage of sugar in fruits of study area varied from 7.84 to 8.65 per cent with mean value of 8.22 per cent. The maximum and minimum sugar contents were recorded in Husansar-II and Bikaner respectively. These results are similar to the findings of Bhatanagar (6).

The maximum, minimum and average value

Table 2: Nitrogen, phosphorus, potassium, sulphur and zinc content of pomegranate cv. Ganesh leaves on orchards of Bikaner district.

Treatments (Orchard Location)	Nitrogen (%)	Phosphorus (%)	Potassium (%)	Sulphur (ppm)	Zinc (ppm)
Gadwala-I	1.015	0.259	1.521	0.203	17.00
Gadwala-II	1.011	0.245	1.516	0.202	17.25
Husansar-I	0.976	0.196	1.463	0.195	16.50
Husansar-II	1.056	0.276	1.584	0.211	20.00
Husansar-III	0.979	0.230	1.411	0.192	9.25
Raisar	0.959	0.222	1.438	0.188	23.00
13 JMD	0.928	0.226	1.392	0.186	23.00
Khichia	0.990	0.203	1.424	0.190	20.00
Nokha	1.028	0.257	1.541	0.205	22.50
Bikaner	0.972	0.184	1.459	0.194	17.00
Average	0.990	0.230	1.475	0.197	18.55
CD(P=0.05)	0.58	0.021	0.201	0.013	1.620
CV(%)	3.46	5.48	4.02	4.02	5.16

of aril percentage were 73.00 per cent, 56.67 per cent and 64.67 per cent, respectively in study area (Table 3). Similar findings have also been reported by Bhatanagar (6).

The maximum (52.00 per cent) and minimum (35.68 per cent) juice contents were recorded in fruits of Husansar-II and Husansar-I, respectively with the mean value of 44.67 per cent (Table 3). These results are similar to the findings of Bhatanagar (6).

Yield and qualitative attributes of ber under influence of soil nutrient status

Data as regard to available organic carbon, nitrogen, phosphorus, potassium, sulphur and zinc in ber orchard are presented in Table 4. The mean value of organic carbon was 0.18 per cent, nitrogen 86.05 kg ha ^{1}, phosphorous 14.11 kg ha ^{1}, potassium 130.73 kg ha ^{1}, sulphur 12.13 ppm and that of zinc was 0.32 ppm. Among all the orchards of the study area, the maximum organic carbon content of 0.22 per cent was found at Gadwala orchard. The maximum nitrogen content 111.00 kg ha ^{1}, P 16.46 kg ha ^{1}, K 156.00 kg ha ^{1} and S 13.86 ppm were found in orchard of Pemasar and the maximum zinc content of 0.53 ppm was found in the orchard at Nokha. However, the maximum N content 52.50 kg ha ^{1}, P 8.84 kg ha ^{1} and S 9.38 ppm were found in orchard of Sagar–I. In respect to organic carbon the value was 0.11 per cent. K 108.00 kg ha ^{1} and Zn 0.18 ppm in the orchard of Raisar- I.

The data related to nutrient content in leaves are presented in Table 5. The maximum nitrogen

Table 3: Fruit weight, T.S.S., acidity, total sugars, aril percentage and juice percentage of fruit of pomegranate cv. Ganesh orchards of Bikaner district.

Treatments (Orchard Location)	Fruit Weight (g)	TSS (°Brix)	Acidity (%)	Total Sugar (%)	Aril (%)	Juice in Fruit (%)
Gadwala-I	243.30	13.31	0.410	8.44	70.67 (57.17)	50.67 (45.34)
Gadwala-II	158.32	10.44	0.408	8.17	59.33 (50.36)	39.33 (38.82)
Husansar-I	88.33	10.46	0.410	8.11	55.67 (48.22)	35.68 (36.63)
Husansar-II	243.00	15.99	0.300	8.65	73.00 (58.69)	53.00 (46.72)
Husansar-III	226.70	14.43	0.390	8.09	64.33 (53.31)	44.32 (41.67)
Raisar	171.67	15.69	0.457	8.05	59.33 (50.37)	39.33 (38.82)
13 JMD	238.33	13.17	0.390	8.39	67.67 (55.30)	47.67 (42.62)
Khichia	228.31	14.69	0.380	7.95	65.00 (53.73)	45.00 (42.13)
Nokha	241.68	14.47	0.415	8.53	72.00 (58.05)	52.00 (46.15)
Bikaner	135.00	15.00	0.390	7.84	59.67 (50.53)	39.67 (39.00)
Average	197.67	13.76	0.400	8.22	64.67	44.67
CD(P=0.05)	22.79	1.62	0.043	0.441	4.45	4.45
CV(%)	6.77	6.94	6.32	3.15	4.04	5.85

Figures in parentheses indicate the angular transformed values.

(1.20 per cent) was noted in a orchard at Pemasar, phosphorous (0.279 per cent) in orchards of Raisar-II, potassium (1.99 per cent) and zinc (11.00 ppm) in the plant leaves of orchard at Sagar-I. Sulphur content was 0.22 ppm in the orchards at Napasar-II and minimum nitrogen (0.79 per cent) was there in orchard of Sagar-I, potassium content was 1.45 per cent in orchard of Nokha and zinc content was 6.15 ppm in orchard of Raisar-II with the mean value of N 1.01 per cent, P 0.23 per cent, K 1.81 per cent, S 0.20 ppm and Zn 7.98 ppm.

Data related to yield and qualitative attributes of ber cv. Gola are presented in Table 6. It is evident from the data that the fruit weight varied significantly in different orchards due to prevailing nutrient status of the soil condition in the study area. The maximum fruit weight (32.17 g), length (4.13 cm), T.S.S. (18.70 °Brix), pulp (94.66 %), pulp to stone ratio (17.88:1) and total sugar (10.24%) were found in orchards at Pemasar. The maximum fruit breadth (3.77 cm) was found in the orchards at Sagar-II and acidity (0.587 per cent) in the orchards at Nokha. The minimum fruit weight (14.45 g), breadth (1.97 cm), length (2.76 cm), T.S.S. (14.00 °Brix), pulp per centage (88.00 per cent), pulp to stone ratio (9.00 : 1) were noted in the orchard at Raisar – I. The fruit acidity was 0.50 per cent in the fruits in the orchard at Sargar-II and the total sugar contents was 8.84 per cent at the orchard of Sagar –I with the mean value of 22.39 g, 3.38 cm, 2.80 cm, 16.59 °Brix, 0.53 per cent, 8.4 per cent, 92.50 per cent and 13.24, respectively.

It is avident from the Table 4 that the low level of organic carbon, nitrogen and zinc may be mainly due to the sandy soil, high temperature, poor permanent vegetation, imbalanced use of nutrient and poor management of soil (Arora *et al.* 3). Phosphorous and sulphur were found in low to medium level. It may be possibly due to low organic carbon, low precipitation, sandy soil and changing cropping pattern (Bhandari, 4) in the study area. Medium level of potassium might be due to presence of potassium bearing minerals (Muscovite, Biotite and Feldspar) in the soil of study area.

All the soil nutrients were found positively correlated with all leaf nutrient and yield and qualitative attributes except phosphorous and zinc

Table 4: Available nitrogen, phosphorus, potassium, sulphur and zinc status of different locations of Ber orchards of Bikaner district.

Treatments (Orchard Location)	Organic Carbon (%)	Nitrogen (Kg ha ^{1})	Phosphorus (Kg ha ^{1})	Potassium (Kg ha ^{1})	Sulphur (ppm)	Zinc (ppm)
Gadwala–I	0.220	86.00	14.61	138.60	13.40	0.20
Napasar–I	0.210	94.50	15.80	140.67	10.94	0.35
Napasar–II	0.193	87.00	16.00	141.33	11.77	0.48
Napasar–III	0.193	87.00	13.94	110.33	12.00	0.20
Raisar–I	0.187	75.00	12.61	108.00	11.43	0.18
Raisar–II	0.113	80.00	13.58	125.53	11.21	0.30
Sagar–I	0.117	52.50	8.84	116.00	9.39	0.25
Sagar–II	0.213	96.00	14.68	137.34	13.86	0.21
Nokha	0.203	91.50	14.67	133.45	13.50	0.53
Pemasar	0.153	111.00	16.46	156.00	13.86	0.50
Average	0.180	86.05	14.11	130.73	12.13	0.32
CD(P = 0.05)	0.020	9.21	1.59	10.93	1.390	0.032
CV(%)	6.72	6.29	6.64	4.91	6.75	5.97

Table 5: Nitrogen, phosphorus, potassium, sulphur and zinc contents of Ber cv. Gola leaves on orchards of Bikaner district.

Treatments (Orchard Location)	Nitrogen (%)	Phosphorus (%)	Potassium (%)	Sulphur (ppm)	Zinc (ppm)
Gadwala – I	0.910	0.264	1.672	0.186	7.40
Napasar –I	0.972	0.212	1.789	0.199	7.20
Napasar –II	1.116	0.210	1.982	0.220	7.47
Napasar –III	1.068	0.205	1.965	0.218	7.23
Raisar –I	0.891	0.205	1.899	0.211	7.37
Raisar – II	1.004	0.279	1.848	0.205	6.15
Sagar –I	0.992	0.200	1.997	0.220	6.87
Sagar –II	1.150	0.267	1.642	0.183	11.00
Nokha	0.793	0.214	1.459	0.162	8.40
Pemasar	1.200	0.271	1.863	0.207	10.73
Average	1.01	0.230	1.810	0.201	7.98
CD(P=0.05)	0.110	0.022	0.338	0.020	0.786
CV(%)	6.59	5.80	6.09	6.09	7.79

Table 6: Fruit quality attributes of ber cv. Gola orchards of Bikaner district.

Treatments (Orchard Location)	Fruit Weight (g)	Fruit length (cm)	Fruit breadth (cm)	TSS (°Brix)	Acidity (%)	Total Sugars (%)	Pulp Percentage (%)	Pulp to stone ratio
Gadwala-I	20.32	2.90	2.30	16.00	0.547	9.20	93.00 (74.66)	13.48:1
Napasar–I	18.64	3.31	1.97	18.50	0.533	9.68	91.66 (73.15)	11.03:1
ustrightNapasar–II	24.03	3.33	2.20	18.67	0.547	9.84	93.66 (75.35)	15.19:1
Napasar–III	22.52	3.16	2.67	15.00	0.520	9.36	92.33 (73.89)	12.22:1
Raisar–I	14.45	2.76	2.27	14.00	0.540	9.52	88.00 (69.73)	9.00:1
Raisar–II	24.42	3.63	3.63	15.67	0.520	9.44	92.66 (74.21)	12.69:1
Sagar–I	22.77	3.60	2.60	17.67	0.513	8.48	93.33 (75.00)	14.27:1
Sagar –II	23.10	3.96	3.77	16.33	0.507	8.81	93.33 (75.00)	14.59:1
Nokha	21.48	3.10	3.00	15.32	0.587	9.60	92.33 (73.89)	12.09:1
Pemasar	32.17	4.13	3.59	18.70	0.540	10.24	94.66 (76.56)	17.88:1
Average	22.39	3.38	2.80	16.59	0.530	9.41	92.50	13.24:1
CD(P=0.05)	3.02	0.56	0.43	1.33	NS	0.884	2.44	1.80
CV(%)	7.95	9.91	9.19	4.74	4.92	5.55	1.55	7.98

which were antagonistically related to each other (Nyak, 15).

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HORTICULTURE AND TASAR FLORA: STATUS, SCOPE AND POTENTIAL UTILIZATION

A.K. Srivastava, Dinesh Kumar, J.P. Pandey, Vijai Kumar[1] and B.C. Prasad

Central Tasar Research and Training Institute, Central Silk Board, Govt. of India, P.O. Piska-Nagri, Ranchi 835303, India.

[1]Department of Horticulture, CSSS (PG) College, Machhra, Meerut, Uttar Pradesh, India.

E-mail-dineshkcsb@yahoo.co.in

ABSTRACT : Tasar culture practiced largely by tribal depended hitherto on a host of tasar host plants naturally available in the forest. Changing social fabric on one hand and the need for conservation of tasar flora on the other call for insight and devising focused strategies sustenance of tasar culture is required. In this backdrop, block plantation of Arjun/Asan are taken up at different spacing, of these plantation with 10 5 has given more profit. It is need of the hour that tasar food plants combined with land husbandry and horticultural plants viz. *Terminalia catappa, Anacardium occidentale, Carissa carandus, Zizyphus jujuba, Eugenia cuminii,* etc are effective means of development as tasar food plants for expansion of tasar flora. It will provide gainful employment opportunities in rural areas which will check migration of rural folk to urban areas.

Keywords : *Horticulture, flora, host plant, silkworm, tasar.*

Agriculture has largely been the main sector providing employment and income to large majority of those living in rural areas of India. The major livelihood of its people comes from agriculture sector that can not provide full employment. Hence diversification from agriculture sector to one of the important aspects which needs to be emphasized to achieve the objective of alleviation of rural poverty and check on migration of village folks to cities which are already overloaded with unemployed persons. One of the activities that generate employment at every stage is Horticulture, Apiculture, Lac culture and Sericulture with special reference to horticulture and Tasar culture. The tasar culture a has long heritage in India and the traditional areas have shown that given proper direction and infrastructural support horticulture and tasar culture simultaneously can provide better scope for rural development and economic transformation has been brought wherein an integrated approach has been adopted for the development of horticulture and tasar culture.

The aim of this article is three fold: firstly, it will provide a general overview of tasar culture; secondly, it will discuss its potential application in horticulture and food symptoms, and thirdly it will high light how some of the horticultural plants are likely to transform growth of economy of poor people along with tasar culture.

TASAR FLORA

Tasar silk production is an excellent example of healthy biological interaction between primary producer (plant) and consumer (silkworm), thus forming an integral part of ideal eco-system. It has often been reported that wherever the industrial civilization has penetrated a zone inhabited by weaker section of the society, the traditional culture and self dependence of the tribal people witnessed a sharp decline. It is under this background that the government of India is giving special attention to the conservation of traditional tribal crafts and forest based industries like tasar. Tropical tasar silkworm *Antheraea mylitta* Drury feeds on a variety of food plants and its polyphagous in nature (Table 1).

However, depending upon acceptability of the foliage and rearing performance, the primary food plants of tasar silkworm are *Terminalia arjuna, T. tomentosa,* Shorea robusta, among these *T.*

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tomentosa and *T. arjuna* are extensively utilized for raising silkworm crop. *Shorea robusta* does not support profitable rearing due to larval mortality, but provides base for collection of the large quantity of nature grown cocoons which are regularly collected from thickly populated Sal trees in different tasar growing states. In view of the above, specific strategies have been taken up separately for existing tasar flora available in the forest and raised economic tasar food plant in different tasar producing states. Tropical tasar cocoons are a minor forest produce and tasar culture are recognized as a forestry practice of the tribal as per forest conservation act 1980.

Table 1: Important host plants of *Antheraea mylitta* Drury.

Sl.No.	Family	Scientific name	Local name
1.	Apocynaceae	*Carissa carandas* L.	Karaunda
2.	Anacardiaceae	*Semecarpus anacardium* L.	Bhelwa
		Anacardium occidentala	Kaju
3.	Caesalpinaceae	*Cassia lanceolata* L.	Kanchan
		Bauhinia variegata L.	Kachnar
4.	Celastraceae	*Celastrus paniculatus* Royle	Malkangni
5.	Combretiaceae	*Terminalia arjuna* Bedd.	Arjun, Sadar.
		T. chebula	Harra
		T. belerica Roxb.	Bhaira, Behera
		T. tomentosa W&A	Asan, Ani, Saja
		T. alata Roth.	-
		Anogeissus latifolia Wall	Dhaura
		T. crenulata Kurz.	-
		T. catappa L.	Jungli badam
6.	*Dipterocarpaceae*	*S. talura Roxb.*	-
		Shorea robusta Gaertn.	Sal or Sakhua
7.	Euphorbiaceae	*Ricinus communis* L.	Castor plant
8.	Lythraceae	*Lagerstroemia indica* L.	Daiyeti, Telinga, China
		L. parviflora Roxb.	Banskli/Sidha
9.	Malvaceae	*Bombax heptaphyllum*	Semul
		B. malabaricum DC.	Silk cotton tree
10.	Meliaceae	*Cipadessa fruticosa Bl.*	Billu
11.	Moraceae	*Ficus benjamina* L.	Nandruck
		F. religiosa L.	Aswat, Peepal
		F. retusa L.	Kamrup
12.	Lecythidaceae	*Careya arborea Roxb.*	Kumbi
		C. sphaerica L.	-
13.	Myrtaceae	*Eugenia cuminii* Druce	Jamun
	Rhamnaceae	*Zizyphus jujuba* L.	Ber
		Z. mauritiana L.	Ber
15.	Rosaceae	*Prunus domestica* Pleem.	-
16.	Rhizophoraceae	*Rhizophora candelaria* DC	-
17.	Rubiaceae	*Canthium diecocum* Gaertn.	Merrill
18.	Sapindaceae	*Dodonaea visosa* Jacg. (L)	Sanatta
19.	Sapotaceae	*Bassia latifolia* Roxb.	Mohua
		B. longifolia L.	-
20	Verbenaceae	*Tectona grandis* L.	Sagaun

TASAR SILKWOAM FAUNA

Tasar silkworm is basically wild in nature. However, through research interventions, it has achieved a semi-domesticated status. Distribution of tasar insect, A. mylitta reveals that the species was available throughout the Indian peninsula and with gradual depletion of forest cover due to increasing use of land and urbanization; habitat lost its continuity and resulted in geographic isolation. This geographic isolation allowed the populations to continue separately for generations to attain a equilibrium in its genotypic, phenotypic and behavioral characteristics identified with particular ecological niche and food plant association led to consider them as separate unit within the same species and so for 44 ecoraces have been determined and recorded (Suryanarayana and Srivastava, 22). Moreover, many of its ecoraces like Raily, Modal, Laria etc are wild in nature and the tribals only collect the cocoons from the forest. Semi-domesticated ecoraces like Daba and Sukinda are reared on Asan and Arjun by the tribals under their care and supervision. These two ecoraces are also extensively utilized for seed and commercial rearing.

TASAR CULTURE AND HORTICULTURAL CROPS

Like other agricultural and horticultural crops tasar is labour oriented, self employment generation cottage industry and its economics is not comparable to the income from other agricultural/ horticultural cash crops. This is mainly because of the fact that the tasar farmers are landless farmers and depend upon tasar plantation raised in the government sector or plantations available in the forest. Further , tasar culture is practiced as an alternate source of income and it is not a main source of income. Tasar culture is practiced as seasonal activity and in general farmers take up only one or two crops which hardly involves two or three months of labour. The farmers who take up one crop (rearing of 200 disease free layings) in a year can earn up to 20,000/- per annum from sale of cocoons (Srivastava *et al*., 1).

In order to make it more remunerative and continuance of tasar culture as an eco-friendly

Table 2: Quantitative characters of the cocoons fed on different horticultural crops.

Characters	Food plants				
	Anacardium occidentale	***Carissa carandus***	***Terminalia catappa***	***Zizyphus jujuba***	***Eugenia cuminii***
Larval weight (g)	14.35 (12.57 to17.79)	18.80 (15.20 to 0.52)	15.26 (12.57 to17.79)	19.40 (17.23 to25.20)	17.25 (15.23 to 20.5)
Cocoon weight (g)	6.14 (3.48-7.09)	8.80 (6.5 to 12.52)	6.23 (4.16 to 6.42)	9.47 (5.57 to 14.93)	7.38 (3.95 to 11.60)
Shell weight (g)	0.65 (0.47 to 0.92)	1.02 (0.82 to 1.62)	0.64 (0.39 to 0.830	1.08 (0.80 to 2.62)	1.16 (0.64 to 1.90)
Cocoon length (mm)	35.96 (30.6 to 40.9)	38.2 (30.7 to 41.9)	38.25 (30.7 to 43.2)	55.00 (42.0 to 65.0)	37.00 (35.0 to 40.0)
Cocoon breadth (mm)	21.05 (18.4 to 23.3)	21.32 (15.8 to 24.3	22.38 (18.7 to 26.5)	28.00 (22.0 to 33.0)	28.0 (26.2 to 30.2)
L/B Ratio	1.72 (1.66 to 1.76)	1.70 (1.65 to 1.72)	1.60 (1.63 to 1.69	2.80 (2.1 to 3.2)	1.30 (1.29 to 2.4)
Peduncle length	3.81 (3.1 to 5.6)	3.40 (2.8 to 4.5)	3.50 (3.0 to 3.8)	3.97 (2.9 to 6.1)	3.20 (3.0 to 4.2)
Silk ratio (%)	10.93	11.60	11.38	11.78	15.82

cottage industry and strengthening of economy, it is important to raise block plantation of tasar food plants. Block plantation of Arjun/Asan are required to be taken up with 10' x 5' spacing combined with horticultural crops which are secondary food plants of tasar silkworm. These food plants along with quantitative traits of cocoons are presented in table 2. Some of the ecoraces viz. KE02 from Kerala and Jalpa of Jharkhand is based on *Anacardium occidentale* (Kaju) and *Zizyphus jujuba* (Ber), respectively.

STRATEGIES FOR EXPANSION

1. Tasar food plants may be grown in waste land under afforestation programme. It has been established that plantation of tasar food plants combined with crop husbandry and horticultural crops are effective means for economic development of farmers. Forest development is having concern for expansion of tasar flora, so steps are required to be taken up in over all coverage under afforestation programme in open forest land.

2. Afforestation programme may be taken up on degraded forests under JFMS (Joint Forest Management Programme) through co-operative societies in collaboration with horticulture, Sericulture and forest departments.

3. Mutual co-operation between horticulture department and State sericulture department, Central Silk Board and NGOs can yield long term benefits like participatory approach conservation of tasar and horticultural plants and social up liftment in the rural areas. The role dedicated and enthusiastic NGOs in the development of horticultural and tasar food plants need not be over emphasized. In this regard the joint forest management and Van Suraksha Samiti become integral part of the component for potential utilization of tasar flora, fauna and horticultural crops.

4. Gestation period of tasar food plants is at least 5 years and farmers has to weight during that period for undertaking tasar silkworm rearing to make tasar culture more remunerative and to develop economic conditions of the tribal vegetable crop like Labia, French bean, ginger turmeric etc. may be taken up as intercropping.

CONCLUSION

Horticulture and sericulture in general and tasar culture in particular has a special relevance with respect to tribal development. The employment potential with minimum financial investment and no adverse effects in the environment and ecosystem has been recognized in these sectors. Tasar industry has rich resources of food plants which include horticultural plants as well and man power and challenge is to utilize these to bring about a balanced development in keeping with traditions and the way of life of the tribals. Since tasar culture provides gainful employment opportunities in rural area it has helped in checking migration of rural folk to urban areas.

As tasar silkworm rearing is involved only biological components, there are no side effects or hazards of pollution and environmental degradation. From the point of eco-development any afforestation developmental programme should be taken up on the basis of fullest sustainable advantage of localities, physical, biological and cultural resources. In this context the horticulture and tasar culture fit very well with eco-development as it gives edible fruits as food security and tasar gives cocoons without jeopardizing the growth and ecosystem.

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INFLUENCE OF NITROGEN, PHOSPHORUS AND POTASSIUM FERTILIZERS ON YIELD AND QUALITY OF GRAPES CV. PERLETTE

N.K. Arora, M.I.S. Gill and Navjot[1]

Department of Horticulture, Punjab Agricultural University, Ludhiana, Punjab

[1]PAU Regional Station, Bathinda, Punjab

ABSTRACT: The present studies were conducted to ascertain the effect of different combinations of N, P and K fertilizers on the yield and quality of Perlette grapes. The yield and quality characteristics varied with the different combinations of N, P and K. The mean pooled data indicates that the maximum number of bunches/vine (2.28) were obtained in $N_1P_1K_1$ combination. The mean bunch weight was however, significantly higher (497.2g) in a fertilizer combination $N_1P_2K_2$ followed by combination $N_1P_1K_2$ (469.3). The higher yield /vine (10.3 kg) was obtained in $N_1P_2K_2$ combination. The quality parameters viz., TSS, acidity and TSS/Acid ration also varied with change in fertilizer dose. The significantly higher TSS (19.1%) was obtained in the bunches harvested from the vines given 75g N, 50 g P and 150 g K. The TSS/Acid ratio was significantly higher (37.3). Thus the fertilizer combination $N_1P_1K_2$ (75g N, 50 g P and 150 g K)/ year age of vines should be recommended in vineyards to obtain higher yield and better quality fruits.

Keywords : *Grapes, nitrogen, phosphorus, potassium, growth, quality.*

Grapes produce higher yields and fetch extra farm income per unit area than most field and fruit crops. High yield of fruits exhausted the plant and soils essential elements needed for proper growth and development. Hence, various elements are required to be replenished regularly in sufficient quantity to keep the fruit tree in healthy and productive condition. Nutrient removal by fruits and its use efficiency indicate mining of nutrients from soil (Hedge and Sudkara Babu, 4 and Patil *et. al*., 6). The nutrient use efficiency of N ranged from 20 to 40%, P from 5 to 20% and K from 50 to 100%, depending on the variety, growth rate and production potential. In grapevines, nitrogen has shown its effect in terms of growth, P in fruit bud differentiation and root growth and potassium for cane maturity, crop quality and shelf-life of bunches. It is not N, P and K concentration, which individually affect bud differentiation but a proper balance between them induces the bud either to develop into a fruitful bunch or a non-productive tendril (Bhargava, 1). Keeping in view of these the present study was therefore undertaken to know the effect of N, P and K application and their interaction on the quality and yield performance of grapes.

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MATERIALS AND METHODS

The experiment was conducted at New orchard, Punjab Agricultural University, Ludhiana. In the trial, NPK doses in 27 different combinations were tested on the grapes cv. Perlette. Urea (46% N) was used as a source of nitrogen and was added as 0, 75, 150 g (N_0, N_1, N_2) nitrogen/ year age of vines. While, super phosphate (16% P_2O_5) was used as 0, 50, 100g (P_0, P_1, P_2) phosphorus/year age of vines. Murate of potash (MOP) was used as a source of potash to have 0, 75, 150g (K_0, K_1, K_2) potash/year age of vines. The entire dose of phosphorus and half dose of nitrogen and potassium were applied in February and remaining dose of nitrogen and potassium was given in month of April at full bloom. The crop was harvested in the first fortnight of June at berry ripening stage. The fruit yield attributes such as number of bunches/vine, bunch weight, berry weight, yield per vine and quality parameters such as T.S.S., Acidity, T.S.S./acid ratio and brix yield were recorded for the three fruiting years viz., 2002-03, 2003-2004 and 2004-05. The experiment was laid out in Factorial RBD with three replications.

RESULTS AND DISCUSSION

Yield Attributes

The data pertaining to yield and yield attributes of fruits as influenced by the application of different levels of N, P and K in grapes are presented in Tables 1&2. Nitrogen, phosphorus and potassium application to grapes showed beneficial effect on fruit yield. During 2002-03, the maximum no. of bunches per vine (20.6) were obtained in $N_0P_1K_0$ combination, which was closely followed by $N_1P_1K_1$ combination. While during the years 2003-04 and 2004-05, significantly higher no. of bunches per vine (21.6) and (29.3) were obtained in combination $N_1P_1K_1$ (75 g N, 50 g P and 75 g K) and $N_1P_1K_2$ (75 g N, 50 g P and 150 g K) respectively. The maximum bunch weight (546 g) during 2002-03, was obtained in $N_1P_2K_2$ combination, where 75 g N, 100 g P and 150 g K was applied per year age of vines. Potassium promotes fruitfulness through activating the enzymes involved in the conversion of carbohydrates to ribose sugar, which is a component of RNA. Application of potassium was found to increase the bunch number per vine (Gopalswamy and Madhav Rao, 3). Consequently, the maximum yield per vine (8.89 kg) was also obtained in the same combination. As far as the bunch weight is concerned in the year 2003-04 and 2004-05, the similar trend was noticed, where the highest bunch weight of 390g and 555.6g, respectively was also obtained $N_1P_2K_2$ fertilizer combination. Sidhu and Thakur (7) had also reported an increase in bunch weight with higher levels of N-P-K . The bunch weight in this combination was significantly higher than combination $N_1P_1K_1$ where maximum number of bunches/ vine was obtained. In 2003-04, the maximum yield (7.06 kg) was obtained in $N_2P_0K_0$ combination, while it was at par with $N_1P_2K_2$ (7.02) and $N_1P_1K_2$ (6.90). The higher yield/vine (15.1kg) was obtained in $N_1P_1K_2$ combination where 75 g N , 100 g P and 150 g K was applied to the plants during 2004-05. Potassium has an additive effect in increasing the bunch number per vine along with N. Quaggio *et al.* (8) had also reported that P and K were the most effective nutrients to increase fruit size. The berry weight had a different trend than the bunch weight and yield/ vine; it was highest 210g, 343g and 295g in $N_1P_1K_2$ combination, where 75g N, 50g P and 150 g K were added per year age of the vines during the three consecutive years 2002-05.

Fruit Quality Attributes

In general, the different fertilizer combination of NPK had a varied effect on the fruit quality parameters. The maximum T.S.S. (19.0) was obtained (Table 3) in bunches, from the vines, which were given $N_1P_1K_2$ fertilizer application. Likewise, in the year 2003-04 and 2004-05, the highest percent T.S.S. of 19.3 and 19.0 was also obtained in the same combination. This may be due to the reason that adequate K is needed for translocation of sugars to the berries. Though, the trend is clear that the highest T.S.S. is obtained when 75 g N, 50 g P and 150 g K was applied per year age of the vines. However, the T.S.S. obtained was at par with that obtained in the combinations $N_0P_1K_2$, $N_1P_2K_1$ and $N_1P_2K_2$ in 2002-03 and $N_1P_2K_0$, $N_1P_2K_2$ in 2003-04. Potassium influenced berry quality attributes more than other applied mineral elements (Mohammad and Esmaeil, 5). Faruqi and Satyanarayana (2) had also reported reduction in the acidity of the juice in Anab-e-Shahi due to potassium.

Although, the percentage acidity ranged from 0.46-0.60 (2002-03), 0.50-0.64 (2003-04) and 0.46-0.62 (2004-05), but it was at par in all the combinations tried in three years. Among different NPK combinations tried, the highest T.S.S./acid ratio (39.1) was obtained in $N_1P_2K_1$ combination, closely followed by $N_1P_1K_2$ combination, which was also the best combination to yield highest T.S.S/acid ratio (35.0 and 39.0) in 2003-04 and 2004-05 respectively (Table 4). The maximum brix yield (162.6) in 2002-03, was obtained in $N_1P_2K_2$ combination, while in 2003-04 and 2004-05, the maximum brix yield of 133.1 and 279.5 was

Table 1: Effect of different fertilizer combinations on yield attributes in grape cv. Perlette.

Fertilizer Combinations	Yield attributes					
	No. of bunches/vine			Bunch weight (g)		
	2002-03	2003-04	2004-05	2002-03	2003-04	2004-05
$N_0P_0K_0$	11.6	15.6	21.0	285.0	313.3	291.0
$N_0P_0K_1$	17.0	16.3	20.3	322.0	300.0	302.3
$N_0P_0K_2$	16.3	16.0	18.6	374.6	280.0	314.0
$N_0P_1K_0$	20.6	18.0	169.3	327.6	350.0	322.6
$N_0P_1K_1$	16.3	16.6	18.3	359.0	309.0	337.6
$N_0P_1K_2$	15.0	15.3	17.0	402.0	313.3	332.0
$N_0P_2K_0$	12.0	16.3	18.6	302.0	323.3	348.6
$N_0P_2K_1$	17.0	17.3	18.3	356.0	333.6	362.0
$N_0P_2K_2$	16.0	15.3	20.3	352.0	330.0	416.0
$N_1P_0K_0$	11.3	16.0	22.3	393.3	353.3	412.0
$N_1P_0K_1$	12.0	16.6	25.0	511.6	318.3	419.6
$N_1P_0K_2$	12.6	14.6	27.0	524.0	270.0	441.3
$N_1P_1K_0$	12.3	19.6	28.0	411.0	363.3	435.3
$N_1P_1K_1$	20.0	21.6	27.0	411.6	305.3	510.0
$N_1P_1K_2$	12.6	18.3	29.3	529.0	377.3	501.6
$N_1P_2K_0$	18.0	19.0	28.0	456.3	356.6	481.6
$N_1P_2K_1$	10.6	14.3	28.0	540.3	350.0	430.0
$N_1P_2K_2$	19.3	18.0	27.3	546.0	390.0	555.6
$N_2P_0K_0$	19.3	19.0	25.6	310.0	371.6	425.0
$N_2P_0K_1$	9.3	12.3	24.3	305.6	336.0	434.3
$N_2P_0K_2$	18.3	17.3	22.0	512.6	319.6	417.3
$N_2P_1K_0$	16.0	17.3	22.0	331.0	353.3	407.6
$N_2P_1K_1$	18.6	18.6	18.0	297.0	296.0	391.0
$N_2P_1K_2$	11.6	16.6	18.6	356.6	372.3	382.0
$N_2P_2K_0$	13.3	17.3	20.3	361.3	363.3	373.3
$N_2P_2K_1$	13.3	16.3	20.0	346.3	359.6	363.3
$N_2P_2K_2$	9.0	16.0	18.6	371.6	320.0	331.0
CD (P=0.05)	1.31	1.96	1.73	9.2	8.5	8.7

Table 2 : Effect of different fertilizer combinations on yield attributes in grape cv. Perlette.

Fertilizer Combinations	Yield attributes					
	Berry weight (g)			Yield/ vine (kg)		
	2002-03	2003-04	2004-05	2002-03	2003-04	2004-05
$N_0P_0K_0$	175.0	290.0	193.3	3.30	4.88	6.1
$N_0P_0K_1$	185.0	276.6	205.3	5.47	4.89	6.1
$N_0P_0K_2$	140.0	266.6	201.6	6.10	4.48	5.8
$N_0P_1K_0$	150.0	243.3	200.0	6.74	6.30	5.2
$N_0P_1K_1$	93.3	240.0	206.6	5.85	5.12	6.1
$N_0P_1K_2$	166.6	290.0	195.0	6.03	4.79	5.6
$N_0P_2K_0$	163.3	273.3	205.0	3.62	5.26	6.5
$N_0P_2K_1$	183.3	253.3	212.0	6.02	5.82	6.6
$N_0P_2K_2$	180.0	280.0	199.3	5.63	5.04	8.4
$N_1P_0K_0$	183.3	260.0	207.3	4.44	5.65	9.1
$N_1P_0K_1$	180.0	280.0	209.6	6.13	5.28	10.4
$N_1P_0K_2$	196.6	250.0	210.3	6.60	3.94	11.9
$N_1P_1K_0$	180.0	280.0	225.6	5.05	6.62	12.1
$N_1P_1K_1$	173.3	276.6	265.0	8.23	6.59	13.7
$N_1P_1K_2$	210.0	343.3	295.0	6.66	6.90	14.7
$N_1P_2K_0$	205.0	293.3	271.0	8.21	6.77	13.4
$N_1P_2K_1$	206.6	300.0	275.0	5.72	5.00	12.0
$N_1P_2K_2$	186.6	250.0	283.3	8.89	7.02	15.1
$N_2P_0K_0$	158.3	306.6	255.0	5.98	7.06	10.9
$N_2P_0K_1$	175.0	246.6	238.3	2.84	4.13	10.5
$N_2P_0K_2$	200.0	263.3	234.0	7.07	5.52	9.17
$N_2P_1K_0$	171.6	303.3	216.0	5.29	6.11	8.1
$N_2P_1K_1$	121.6	246.6	206.0	4.89	5.50	7.0
$N_2P_1K_2$	176.6	273.3	190.6	4.13	6.18	7.1
$N_2P_2K_0$	155.0	273.3	184.0	4.80	6.28	7.5
$N_2P_2K_1$	173.3	270.0	176.6	4.60	5.86	7.2
$N_2P_2K_2$	171.6	260.0	163.3	3.34	5.12	6.1
CD (P=0.05)	12.3	14.1	15.8	0.21	0.18	0.42

Table 3: Effect of different fertilizer combinations on fruit quality in grape cv. Perlette.

Fertilizer Combinations	Fruit quality parameters					
	T.S.S. (%)			Acidity (%)		
	2002-03	2003-04	2004-05	2002-03	2003-04	2004-05
$N_0P_0K_0$	16.5	16.6	14.6	0.58	0.54	0.58
$N_0P_0K_1$	15.1	15.6	15.3	0.55	0.50	0.61
$N_0P_0K_2$	15.6	16.3	14.6	0.48	0.55	0.62
$N_0P_1K_0$	18.0	16.6	15.0	0.47	0.64	0.57
$N_0P_1K_1$	15.6	15.3	15.6	0.48	0.62	0.57
$N_0P_1K_2$	18.3	17.3	15.3	0.52	0.54	0.61
$N_0P_2K_0$	18.1	18.0	14.3	0.58	0.54	0.56
$N_0P_2K_1$	16.1	17.3	14.6	0.53	0.52	0.56
$N_0P_2K_2$	16.6	17.0	15.3	0.50	0.58	0.60
$N_1P_0K_0$	16.8	16.3	15.3	0.55	0.63	0.58
$N_1P_0K_1$	17.3	15.0	15.0	0.55	0.54	0.60
$N_1P_0K_2$	15.1	15.0	16.3	0.52	0.54	0.54
$N_1P_1K_0$	15.5	17.6	16.6	0.51	0.60	0.54
$N_1P_1K_1$	17.1	16.0	17.0	0.53	0.59	0.50
$N_1P_1K_2$	19.0	19.3	19.0	0.50	0.55	0.48
$N_1P_2K_0$	17.8	18.6	17.3	0.55	0.56	0.48
$N_1P_2K_1$	18.5	17.0	16.6	0.47	0.54	0.49
$N_1P_2K_2$	18.3	18.3	18.0	0.52	0.55	0.47
$N_2P_0K_0$	16.8	17.3	17.3	0.60	0.59	0.46
$N_2P_0K_1$	16.3	16.3	16.6	0.58	0.63	0.49
$N_2P_0K_2$	17.3	17.0	17.0	0.46	0.55	0.53
$N_2P_1K_0$	17.0	17.3	16.6	0.56	0.53	0.54
$N_2P_1K_1$	15.0	16.3	17.0	0.53	0.63	0.49
$N_2P_1K_2$	17.8	15.6	16.3	0.48	0.56	0.49
$N_2P_2K_0$	16.0	16.3	16.3	0.52	0.54	0.50
$N_2P_2K_1$	17.1	15.0	15.6	0.50	0.52	0.53
$N_2P_2K_2$	16.0	16.3	16.0	0.54	0.55	0.56
CD (P=0.05)	0.71	0.93	0.88	0.21	0.19	0.22

Table 4: Effect of different fertilizer combinations on fruit quality in grape *cv*. Perlette.

Fertilizer Combinations	Fruit quality parameters					
	T.S.S/acid ratio			Brix yield (kg/vine)		
	2002-03	2003-04	2004-05	2002-03	2003-04	2004-05
$N_0P_0K_0$	28.1	31.3	25.2	54.4	81.0	89.5
$N_0P_0K_1$	27.5	31.0	24.6	84.7	76.2	94.2
$N_0P_0K_2$	32.2	29.6	23.6	95.1	73.0	85.9
$N_0P_1K_0$	37.9	25.4	26.0	121.3	104.5	78.9
$N_0P_1K_1$	32.2	24.8	27.2	91.2	78.3	99.0
$N_0P_1K_2$	35.2	32.0	25.1	110.3	82.8	86.4
$N_0P_2K_0$	30.9	33.4	25.5	65.5	94.6	93.2
$N_0P_2K_1$	34.1	33.4	26.2	96.9	100.6	97.3
$N_0P_2K_2$	33.3	29.0	25.3	93.4	85.6	129.6
$N_1P_0K_0$	30.5	26.4	26.3	74.5	92.0	140.9
$N_1P_0K_1$	31.5	28.0	24.7	106.0	79.2	157.2
$N_1P_0K_2$	29.2	27.8	30.1	99.6	109.5	194.5
$N_1P_1K_0$	30.4	29.4	30.8	78.2	125.3	203.1
$N_1P_1K_1$	32.3	26.7	34.0	140.7	105.4	232.9
$N_1P_1K_2$	38.0	35.0	39.0	126.5	133.1	279.5
$N_1P_2K_0$	32.4	33.1	36.1	146.1	125.9	233.8
$N_1P_2K_1$	39.1	31.5	33.8	105.8	85.0	199.2
$N_1P_2K_2$	35.3	33.3	38.0	162.6	128.4	273.2
$N_2P_0K_0$	28.0	28.3	37.6	100.4	122.1	188.9
$N_2P_0K_1$	27.8	25.7	33.6	46.2	67.3	176.1
$N_2P_0K_2$	37.6	30.8	32.0	122.3	93.8	155.9
$N_2P_1K_0$	30.3	32.7	30.8	89.9	105.7	135.7
$N_2P_1K_1$	28.3	25.8	34.4	73.3	89.6	119.5
$N_2P_1K_2$	36.6	27.8	33.1	73.5	96.4	116.5
$N_2P_2K_0$	30.7	30.4	33.3	76.8	102.3	126.5
$N_2P_2K_1$	34.3	28.5	29.6	78.6	87.9	113.6
$N_2P_2K_2$	29.5	32.1	28.5	53.4	83.4	98.7
CD (P=0.05)	1.08	1.24	1.20	9.65	7.25	5.38

obtained in $N_1P_1K_2$ where 75 g N, 50g P and 150 g K was applied to the vines.

It can be concluded from three year data on fertilizer trail, that highest T.S.S, the T.S.S/acid ratio and the brix yield was obtained in the combination $N_1P_1K_2$, where 75g N, 50 g P and 150 g K was added to the plants. While the maximum yield/ vine was obtained in the combination $N_1P_2K_2$, where 75g N, 50 g P and 150 g K was applied to the plants.

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EVALUATION OF ORCHID SPECIES UNDER SUB-TROPICAL MID-HILLS OF MEGHALAYA

Rajiv Kumar[1], Bidyut C. Deka and A.R. Roy

Division of Horticulture, All India Co-ordinated Research Project on Floriculture
ICAR Research Complex for NEH Region, Umiam 793 103, Meghalaya
Present address: [1]Division of Ornamental Crops, Indian Institute of Horticultural Research, Hessaraghatta lake Post, Bangalore 560 089, Karnataka
E-mail: flori_rajiv@yahoo.co.in

ABSTRACT: Orchids are internationally acclaimed for their exquisite flower forms and attractive colours. Forty orchid species were evaluated for vegetative and flowering characters at ICAR Research complex for NEH region, Umiam, Meghalaya during 2009-10. The findings revealed that plant height ranged from 5.06 cm (*Pleione maculata*) to 140.00 cm (*Thunia marshalliana*). Significantly maximum number of stems/plant was recorded in *Arundina bambusifolia* (15.83). *Epidendrum* sp. recorded maximum stem length (130.50 cm) and internodal length (9.68 cm). However, maximum number of leaves/plant (99.76) and spikes/plant (17.80) was recorded in *Coelogyne nitida*. Earliest flowering was recorded in *Dendrobium aphyllum* (136 days) while it was delayed in *Cymbidium giganteum* (829 days). Number of flowers/spike varied from 1.00 (*Paphiopedilum spicearianum*) to 140.02 (*Aerides multiflorum*). Significantly maximum spike length (90.00 cm) and spike durability (58.90 days) was recorded in *Calanthe masuca* and *Cymbidium hybrid,* respectively. Flower size varied from 0.83 cm (*Pholidota* sp.) to 13.63 cm (*Paphiopedilum villosum*), while *Phaius tankervilliae* (7.86 cm) recorded the longest pedicel. Species *Calanthe masuca*, *Cymbidium giganteum, Dendrobium nobile, Phaius tankervilliae*, *Renanthera imschootiana, Thunia marshalliana, Vanda coerulea* were found promising as cut flower.

Keywords : *Orchids, evaluation, flowering, north eastern region.*

Orchids occupy a prime position in global cut flower trade due to their brilliant colours, delightful appearance, myriad sizes, shapes, forms and long lasting qualities. North Eastern Hill (NEH) region of India is rich in orchid diversity due to existing conducive climatological and phytogeographical conditions. Out of 800 orchid species distributed in the north eastern region of India, 352 species belonging to different genera were reported from Meghalaya. The study deals with the performance of 40 orchid species belonging to 16 genera and to notes the better performers for commercial exploitations under shade net house in sub-sub tropical mid hills of Meghalaya. Performance of orchid species from NEH region (Apang and Rao, 2; Devadas *et al.,* 3; Munsi *et al.,* 5; and Roychowdhury *et al.*, 7) and other parts of the country (Geetha, 4; Ramachandrudu, 6; Sundaram *et al.,* 8) have been reported.

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MATERIALS AND METHODS

The experiment was carried out at research farm of Division of Horticulture, ICAR Research Complex for NEH Region, Umiam, Meghalaya during 2009-10. Umiam is situated at 25° 41/ N' latitude, 91° 55' E longitude and 1010 meter altitude. The experiment was laid out in completely randomized block design (CRD) with 40 treatments (orchid species) *i.e. Aerides odoratum, Aerides multiflorum, Arundina bambusifolia, Calanthe masuca, Coelogyne barbata, Coelogyne corymbosa, Coelogyne nitida, Cymbidium giganteum, Cymbidium hybrid, Cymbidium mastersii, Cymbidium aloifolium, Cymbidium elegans, Dendrobium nobile, Dendrobium moschatum, Dendrobium densiflorum, Dendrobium aphyllum, Dendrobium chrysanthum, Dendrobium chrysotaxum, Dendrobium wardianum, Dendrobium orchreatum, Epidendrum* sp., *Phaius*

tankervilliae, *Phaius woodfordii, Pholidota sp., Paphiopedilum villosum*, P*aphiopedilum insigne, Paphiopedilum venustum, Paphiopedilum fairrieanum, Paphiopedilum spicearianum, Paphiopedilum hirsutissimum, Pleione praecox, Pleione maculate, Renanthera imschootiana, Rhynchostylis retusa, Spathoglottis plicata, Thunia marshalliana, Vanda coerulea, Vanda teres, Vanda stangeana and Vanda pareshii,* each replicated three times. Each replication had four pots. These species were collected from different location of Meghalaya. The plants were grown in 25 cm earthen pots containing media composed of broken brick pieces, charcoal pieces and moss grass for epiphytic orchids, and broken pot pieces, river sand, leaf mould and compost for terrestrial orchids. The whole experiment was conducted under 75% shade net house. Standard cultural practices were followed uniformly to all the treatments as per their growth habit. Observations on various vegetative and flowering parameters were recorded periodically and were subjected to statistical analysis.

RESULTS AND DISCUSSION

The vegetative and flowering attributes of different orchid species differed significantly.

(a) Vegetative characters

Data presented in Table 1 clearly indicated that there was significant difference among the orchid species for all the vegetative characters. Tallest plant was recorded in *Thunia marshalliana* (140.00 cm) followed by *Arundina bambusifolia* (112.46 cm) and *Calanthe masuca* (110.12 cm) while shortest plants were recorded in Pleione maculata (5.06 cm). Significant variation in plant height in *Dendrobium spp.* (Ramachandrudu, 6; and Roychoudhury *et al.,* 7) and in *Cymbidium spp*. (Munsi *et al.,* 5) has also been reported. The highest number of leaves per plant was recorded in *Coelogyne nitida* (99.76) followed by *Epidendrum sp.* (80.60) while the lowest number of leaves per plant was recorded in *Pleione praecox* and *Pleione maculata* (2.10 and 2.60, respectively). Species *Arundina bambusifolia* (15.83) produced highest number of stems per plant which was followed by *Paphiopedilum venustum* (13.40) and *Dendrobium nobile* (12.90), whereas the least stems per plant was recorded in *Cymbidium elegans* (1.02). Roychoudhury *et al.* (7) has also reported significant differences in number of leaves and shoots per plant in 21 species of *Dendrobium*. Significantly longest stem was recorded in *Epidendrum* sp. (130.50 cm) followed by *Arundina bambusifolia* (91.62 cm) while shortest stem was noted in *Spathoglottis plicata* (2.56). Long Internode was found in *Epidendrum sp.* (9.68 cm) followed by *Dendrobium nobile* (5.46 cm), whereas short internode (0.36 cm) was reordered *Pleione maculate.* Sundaram *et al.* (8) has also reported the variation in vegetative characters of different orchid species.

(b) Flowering characters

Varieties differ themselves for all the flowering parameters under study (Table 2). Species *Dendrobium aphyllum* was recorded early in flowering (136.00 days) whereas *Cymbidium gigantium* was found late in flowering (829.00 days). Maximum number of flowering spikes per plant was recorded in *Coelogyne nitida* (17.80) followed by *Aerides odoratum* (9.36) and *Coelogyne barbata* (6.80) whereas minimum was recorded in *Paphiolpedilum specerianum* (1.00) and *Pleione praecox* (1.00). Significantly longest spikes were produced by *Calanthe masuca* (90.00 cm) followed by *Dendrobium aphyllum* (88.00 cm) and *Cymbidium gigantium* (75.25 cm). The shortest spike (1.26 cm) was produced in *Pleione praecox* (1.26 cm). Large variation was observed in flower size of different species of orchids under study. Species *Paphiopedilum villosum* (13.63 cm), *Cymbidium gigantium* (12.55 cm) and *Phaius tankervillae* (10.98 cm) produced bigger size of flowers. *Orchid Pholidata* sp. produced smallest flowers (0.83 cm). Variation in flowering characters such as number of spikes per plant, number of flowers per spike, spike length and flower size of different orchids has also been reported (*Amin et*

Table 1: Evaluation of orchid species for vegetative characters at Umiam, Meghalaya.

Orchid species	Plant height (cm)	Leaves/ plant	Stems/ plant	Stem length (cm)	Internodal length (cm)
Aerides odoratum	40.12	24.50	5.20	3.28	0.79
Aerides multiflorum	43.09	10.10	4.60	4.61	0.83
Arundina bambusifolia	112.46	33.06	15.83	91.62	5.10
Calanthe masuca	110.12	14.00	12.30	9.40	3.30
Coelogyne barbata	16.00	21.20	8.10	18.12	0.56
Coelogyne corymbosa	15.03	14.13	6.00	3.04	0.83
Coelogyne nitida	35.60	99.76	11.30	7.46	0.76
Cymbidium giganteum	75.20	15.80	10.40	5.98	2.41
Cymbidium hybrid	82.60	11.30	9.30	6.30	3.48
Cymbidium mastersii	36.50	15.00	6.50	12.50	1.28
Cymbidium aloifolium	43.00	12.63	3.00	3.30	0.83
Cymbidium elegans	40.30	16.40	1.02	29.70	0.63
Dendrobium nobile	55.00	45.00	12.90	55.20	5.46
Dendrobium moschatum	50.18	24.00	9.50	43.60	5.38
Dendrobium densiflorum	126.42	36.92	7.00	40.50	5.40
Dendrobium aphyllum	100.56	30.10	6.12	40.00	4.80
Dendrobium chrysanthum	42.40	34.50	4.00	36.05	4.58
Dendrobium chrysotaxum	51.00	12.06	6.50	41.60	5.30
Dendrobium wardianum	57.00	26.50	5.30	44.35	3.42
Dendrobium orchreatum	48.50	21.60	4.60	32.50	3.02
Epidendrum sp.	43.63	80.60	9.35	130.50	9.68
Phaius tankervilliae	61.00	10.20	7.06	40.63	4.60
Phaius woodfordii	64.30	12.60	6.40	36.40	3.82
Pholidota sp.	50.36	8.00	4.36	43.40	0.63
Paphiopedilum villosum	35.06	9.20	11.36	6.60	0.72
Paphiopedilum insigne	42.41	12.40	10.62	5.41	0.83
Paphiopedilum venustum	33.35	10.68	13.40	3.49	0.70
Paphiopedilum fairrieanum	28.40	12.62	1.80	3.60	0.43
Paphiopedilum spicearianum	36.40	10.60	1.20	4.62	0.44
Paphiopedilum hirsutissimum	29.51	11.12	6.20	2.58	1.79
Pleione praecox	15.00	2.10	2.10	4.00	0.53
Pleione maculata	5.06	2.60	1.50	3.50	0.36
Renanthera imschootiana	46.00	24.06	3.40	5.30	1.60
Rhynchostylis retusa	41.50	19.24	3.36	3.62	0.80
Spathoglottis plicata	32.00	8.10	2.16	2.56	0.50
Thunia marshalliana	140.00	40.62	4.62	32.14	5.40
Vanda coerulea	101.40	12.36	3.18	26.02	5.40
Vanda teres	30.00	13.46	2.00	26.50	2.20
Vanda stangeana	26.40	15.00	2.68	28.60	2.36
Vanda pareshii	50.60	12.90	5.42	30.40	4.40
C.D. (P=0.05)	1.86	1.33	1.26	1.82	0.15

Table 2: Evaluation of orchid species for flowering characters at Umiam, Meghalaya.

Orchid species	Days to flowering	Spikes/ plant	Flowers /spike	Spike length (cm)	Flower size (cm)	Pedicel length (cm)	Spike durability (days)
Aerides odoratum	138	9.36	24.72	20.67	3.48	1.63	26.00
Aerides multiflorum	268	1.20	140.02	41.00	1.86	1.26	11.20
Arundina bambusifolia	306	4.60	7.03	12.62	6.70	3.02	15.83
Calanthe masuca	312	2.30	18.30	90.00	2.50	1.60	18.00
Coelogyne barbata	350	6.80	9.65	45.00	7.00	0.88	13.50
Coelogyne corymbosa	348	3.10	3.50	22.16	3.52	1.00	12.00
Coelogyne nitida	178	17.80	15.00	21.60	6.40	3.10	24.30
Cymbidium giganteum	829	3.10	21.24	75.25	12.55	5.40	50.61
Cymbidium hybrid	425	3.67	9.00	60.61	9.66	6.30	58.90
Cymbidium mastersii	362	1.86	10.00	26.50	5.00	4.30	38.00
Cymbidium aloifolium	366	2.60	16.22	50.00	4.20	3.30	28.50
Cymbidium elegans	382	3.16	22.16	36.34	4.90	3.10	33.60
Dendrobium nobile	563	4.69	12.00	33.90	5.56	4.50	15.20
Dendrobium moschatum	482	1.20	11.63	10.60	5.58	2.32	8.80
Dendrobium densiflorum	496	4.28	52.62	20.46	4.06	5.23	15.30
Dendrobium aphyllum	136	3.36	2.90	88.00	3.00	0.60	36.50
Dendrobium chrysanthum	440	4.36	6.68	4.58	4.57	3.43	9.60
Dendrobium chrysotaxum	466	1.12	6.68	4.58	4.57	3.43	9.60
Dendrobium wardianum	396	3.82	3.50	18.20	9.86	3.20	20.40
Dendrobium orchreatum	428	2.46	6.92	12.40	7.52	2.86	32.50
Epidendrum sp.	238	5.52	86.02	18.60	2.53	4.02	34.22
Phaius tankervilliae	306	3.00	6.68	65.00	10.98	7.86	14.50
Phaius woodfordii	318	3.44	5.90	61.00	8.90	6.72	12.31
Pholidota sp.	298	1.32	44.30	13.60	0.83	3.20	9.00
Paphiopedilum villosum	192	3.36	5.06	34.05	13.63	5.60	8.30
Paphiopedilum insigne	179	4.21	1.30	27.37	9.26	3.68	30.54
Paphiopedilum venustum	228	3.92	1.77	30.40	10.82	4.78	25.60
Paphiopedilum fairrieanum	268	1.06	1.02	25.00	6.52	2.40	24.60
Paphiopedilum spicearianum	250	1.00	1.00	30.00	6.00	2.30	28.00
Paphiopedilum hirsutissimum	236	5.53	1.68	18.92	10.92	1.06	21.60
Pleione praecox	220	1.00	3.21	1.26	10.00	0.53	10.40
Pleione maculata	232	1.06	4.30	1.48	5.20	0.40	12.00
Renanthera imschootiana	368	1.10	55.40	20.60	0.88	0.90	8.60
Rhynchostylis retusa	336	2.36	39.50	36.00	2.50	3.02	13.00
Spathoglottis plicata	328	2.10	8.20	30.00	2.50	0.42	14.20
Thunia marshalliana	326	1.16	5.40	15.00	5.86	3.72	25.30
Vanda coerulea	329	2.90	15.50	42.23	5.38	7.18	23.68
Vanda teres	340	2.23	9.63	24.50	2.90	0.60	15.80
Vanda stangeana	310	2.30	14.60	22.10	2.00	0.45	20.86
Vanda pareshii	360	3.40	6.52	2.16	6.46	3.80	40.28
C.D. (P=0.05)	18.20	0.78	0.82	2.12	0.20	0.68	3.35

al., 1; Munsi *et al.,* 5; Ramachandrudu, 6; and Roychoudhury *et al.,* 7). Longest flower pedicel (7.86 cm and 7.18 cm, respectively) was recorded in *Phaius tankervillae* and *Vanda coerulea.* Shortest pedicel (0.40 cm) was recorded in *Pleione praecox*. Significant variation was exhibited in durability of spike which was varied from 8.30 days (*Paphiopedilum villosum*) to 58.90 cm (*Cymbidium hybrid*). Apang and Rao (2) also reported flowering period of 109 species orchid species at Arunachal Pradesh.

Summary

Forty orchid species belonging to 16 genera were evaluated for vegetative and flowering characters at ICAR Research complex for NEH region, Umiam, Meghalaya during 2009-10. Based on the observations recorded, species Calanthe masuca, *Cymbidium giganteum, Dendrobium nobile, Phaius tankervilliae, Renanthera imschootiana, Thunia marshalliana, Vanda coerulea* were found promising as cut flower.

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EFFECT OF GROWTH RETARDANTS ON VEGETATIVE GROWTH, FLOWERING AND FRUITING OF LITCHI CV. CALCUTTIA

Bikramjit Singh [1], Sukhdev Singh and Savreet Sandhu
Department of Horticulture, Khalsa College, Amritsar-143 002
[1]*PAU Regional Research Station, Abohar-152 116.*

ABSTRACT : Present investigation was carriedout during 2009-10 to standardize levels of growth retardants (CCC and PBZ) for proper vegetative growth, flowering and fruiting in litchi cv. Calcuttia, Results revealed that PBZ 7.5 ml proved to be the most effective treatment for suppressing shoot growth, panicle size, male flower percentage, fruit drop and sex ratio. Same treatment resulted in increased hermaphrodite flower percentage, fruit set and fruit retention. PBZ 2.5 ml proved to be the most effective in increasing fruit size and PBZ 5.0 ml in fruit breadth and weight. CCC 2000 ppm resulted in maximum pulp weight, pulp/stone ratio, total soluble solids and minimum acidity whereas CCC 500 ppm found helpful in decreasing seed and peel weight. PBZ 7.5 ml was the most effective treatment in producing maximum sugars (total and reducing) and fruit yield/tree.

Keywords: *Licthi, growth retardant, CCC, PBZ, bearing.*

The litchi (*Litchi chinensis* Sonn.), is the most important sub-tropical evergreen fruit tree, belongs to family Sapindaceae. Botanically it is a nut type of fruit. It is indigenous to south eastern China from where it is considered to have reached eastern India through Myanmar by the end of 17th century or shortly thereafter (Hayes, 7).

In India litchi is grown mainly in the states of Bihar, West Bengal and Uttar Pradesh. It is also grown in limited scale in Tripura, Orissa, Punjab, Himachal Pradesh, Assam and the Nilgiri hills in the south. Current production of litchi is about 4,83,000 MT tonnes from an area of about 74,000 hectares with productivity of 6.5. In Punjab, litchi cultivation is mainly confined to sub-mountainous tracts of Gurdaspur, Hoshiarpur, Nawanshahr, Ropar and union territory of Chandigarh. The problems responsible for low economic potential of litchi cultivation in various litchi growing regions include poor fruit set (Sarkar *et al*., 15), heavy fruit drop (Singh and Phogat, 17), fruit cracking (Bhat *et al*., 2) and inferior fruit quality (Brahmachari and Rani, 3).

Besides these problems irregularity in bearing has remained one of the serious handicaps in the development of litchi industry in many parts of the world including India, Israel, South Africa, Hawaii, Australia and Florida. Litchi bears heavy crop in one year and light or no crop in the adjoining year (Pandey and Sharma, 12). The flushing habit of litchi varieties was intimately connected with irregular bearing. Problem is generally due to failure of flower initiation which puts forth vegetative growth prior to panicle emergence and flowering eliminating the crop completely. Observations on young as well as old 'Calcuttia' trees showed that vegetative growth after September was at the expense of fruiting in the following year (Mustard and Lynch, 10). Several research workers advocated the use of various growth retardants as an alternate approach in litchi to restrict vegetative growth before panicle emergence (Chapman *et al*., 10). Calcuttia litchi was found to be more prone to irregular bearing than other cultivars hence a study was planned to observe the effect of growth retardants on various characteristics of Calcuttia litchi.

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MATERIALS AND METHODS

The present investigations were carried out in a well managed litchi orchard growing at Government Orchard and Nursery, Gurdaspur during 2009-10. The experimental filed is situated in the sub-mountainous region of Punjab at 32º-02′ N latitude and 75º-24′ E longitude with an elevation of 260-300 m above mean sea level. Gurdaspur is situated in the sub-tropical humid zone of Punjab state with an average rain fall of 900 mm. Soil of the experimental orchard was well drained, fertile, sandy loam, with pH of 8.0 and electrical conductivity of 0.15 mmhos/cm.

Selection of trees

Twenty one 15 year old uniform sized litchi cv. Calcuttia trees were randomly selected for the experiment. Each treatment was replicated thrice with a single tree as a treatment unit. All the experimental trees were applied with uniform cultural practices as recommended by PAU, Ludhiana.

Spray schedule

Growth retardant CCC (500, 1000 and 2000 ppm) was applied as foliar application and PBZ (2.5, 5.0 and 7.5 ml/tree) as soil drench in mid-September to selected trees and sub-sequently treatment was repeated in mid-November as superimposed application to same previously treated trees. Trees under control were sprayed with tap water only. The growth retardants were dissolved in desired quantity of water.

Vegetative and floral characters

Shoot length, panicle length, male flower, hermaphrodite flower percentage and sex ratio on the basis of male and hermaphrodite flower percentage was calculated from the selected plants.

Collection and analysis of fruit sample

Fruit sample was collected in last week of June (June 26). At each sampling fruits per treatment and replication were collected randomly from all sides of the trees from previously tagged branches at shoulder height to record various physico-chemical characteristics of fruits. These fruits were analyzed for their physico-chemical characteristics in the laboratory of Department of Horticulture, Khalsa College, Amritsar.

TSS were recorded with hand refractometer and acidity was calculated by titrating the fruit juice with N/10 NaOH solution. Sugars were calculated by the standard procedure given by AOAC

Statistical analysis

There were altogether seven treatments replicated thrice in a Randomized Block design (RBD). The data was analysed as per standard procedures.

RESULTS AND DISCUSSION

Application of Cultar and cycocel reduced the length of terminal shoot and caused more flowering in litchi cv. Calcuttia. All the vegetative and floral parameters were affected more by paclobutrazol than cycocel (Table 1). Minimum length (11.5 cm) of terminal shoots was recorded in soil application of Cultar @ 7.5 ml which was closely followed by Cultar @ 5ml this has been due to antagonism of gibberellin bio-synthesis for which Cultar is known (Desai and Chundawat, 6). There is considerable evidence which showed that Cultar reduced vegetative growth and stem elongation in many fruits by interrupting gibberellic acid synthesis (Burondkar and Gunzate, 4). Cultar was resulted in early physiological maturity and reduced vegetative growth causing higher flower bud initiation. Minimum panicle length/breadth 21.7/9.67 cm was recorded in PBZ 7.5 ml treated plants. Reduction in panicle length in Cultar

treated trees was due to more number of panicles/tree. Cycocel also reduced the panicle size than control but to a lesser extent than PBZ. Lower percentage of male flowers was recorded in PBZ 7.5 ml treatment (74.53 %) than control (81.31 %). Highest percentage of hermaphrodite gibberellins were powerful modifiers of sex expression, thus the reduced endogenous GA levels with the application of PBZ and CCC might be possible factor for the higher proportion of hermaphrodite flowers observed (Table 1). Lower sex ratio was observed in 7.5 ml cultar treatment. Lower sex ratio means lower number of male flowers and higher number of hermaphrodite flowers is due to maintenance of physiological concentration of auxins in plant tissues by the PBZ and cycocel which resulted in increase flowering in general and femaleness in particular. This was precisely the reason of improved sex ratio in present studies confirming the earlier findings of Kulkarni (8), Kurian and Iyer (9) and Singh (16) in mango. Highest fruit set, lower fruit drop, maximum fruit retention was noticed in PBZ 7.5 ml treatment. Minimum fruit retention was found in cycocel 500 ppm.

Longest fruits and highest fruit breadth were noticed under Cultar, smallest fruits and minimum breadth was noticed in cycocel 500 ppm (Table 2). Maximum fruit weight was registered with PBZ 5.0 ml and minimum in fruits harvested from PBZ 2.5 ml treated plants. The highest value of pulp weight was noticed in cycocel 2000 ppm lowest was found in PBZ 2.5 ml while lowest pulp weight seed weight was recorded in cycocel 500 ppm and highest seed weight was registered in PBZ 5 ml. The lowest peel weight was produced in fruits harvested from PBZ 5 ml. Growth retardants affect the peel weight to some extent directly or indirectly via their effect on cell division and cell expansion. Results of present study were corroborated by the findings of Rani and Brahmachari (14) in litchi. Highest total soluble solids were observed with cycocel 2000 ppm. All the treatments helped in producing more TSS than in fruits under control (Table 3). The increase in total soluble solids were might be due to the metabolizing effect of growth retardants and their effect on osmotic pressure of the cells tends to increase and solutes like ions and sugars accumulates and thus the TSS level was increased in treated fruits (Singh, 16). Other reason may be increased efficiency of photosynthetic apparatus (leaves) of PBZ treated plants resulting in increase content of TSS in litchi fruits (Ahmad *et al*., 1).

Lowest acidity was detected in the fruits which were treated with cycocel 2000 ppm than control. PBZ produced high acidity due to the accumulation of organic acids in the fruit sac (Rani and Brahmachari, 14). Maximum TSS/acid ratio was noticed in 2000 ppm cycocel and minimum in control.

Maximum reducing and total sugars was found in PBZ 7.5 ml treatment. All other treatments yielded more total sugars than control. Highest level of total sugars in the fruits treated with growth retardants were due to their action on -amylase synthesis converting starch to reducing sugar. The improvement in first quality with the application of growth regulators might be due to diversion of photosynthesis towards the fruits (Rai and Bist, 13). Similar observations were made by Rani and Brahmachari (14) with CCC in litchi and Singh and Singh (18) with PBZ in mango.

Higher fruit yield (Table 3) was estimated in 7.5 ml PBZ treatment and lowest in control. PBZ and cycocel significantly affect the crop yield, profuse flowering, higher sex ratio, lesser fruit drop and higher fruit retention. PBZ applied contributed to higher fruit yields in litchi as has also been supported by Oosthuizen *et al.* (11). Increase in yield with the soil application of Cultar may have been due to its effect on shifting of assimilates, mineral elements and soluble proteins in leaves, stems and roots (Wang *et al*., 19).

Table 1: Effect of growth retardants on vegetative growth and flowering of litchi cv. Calcuttia.

Treatment	Concentration	Shoot growth (cm)	Panicle length (cm)	Panicle breadth (cm)	Male flower (%)	Hermaphrodite flower (%)	Sex ratio	Fruit set (%)
T1	CCC 500 ppm	17.40	29.47	12.23	77.8	22.2	3.52	45.25
T2	CCC 1000 ppm	15.98	29.35	12.70	77.31	22.69	3.43	49.12
T3	CCC 2000 ppm	15.83	27.03	11.87	76.54	23.46	3.30	54.20
T4	PBZ 2.5 ml	15.66	24.6	11.25	75.97	24.03	3.16	57.15
T5	PBZ 5 ml	13.69	23.8	9.97	75.79	24.21	3.15	62.17
T6	PBZ 7.5 ml	11.57	21.7	9.67	74.53	25.13	2.97	64.10
T7	Control	23.53	30.6	15.06	81.31	18.69	4.44	41.18
	C.D. (P = 0.05)	2.23	3.05	2.69	3.28	3.05	0.68	4.12

Table 2: Effect of growth retardants on fruiting parameters of litchi cv. Calcuttia.

Treatment	Concentration	Fruit drop (%)	Fruit retention (%)	Fruit length (cm)	Fruit breadth (cm)	Fruit weight (g)	Pulp weight (g)	Seed weight (g)
T1	CCC 500 ppm	78.15	10.92	3.23	2.14	17.3	13.96	3.13
T2	CCC 1000 ppm	73.33	14.20	3.37	3.09	21.08	16.37	3.56
T3	CCC 2000 ppm	71.72	18.82	3.43	3.17	20.68	17.06	3.15
T4	PBZ 2.5 ml	69.28	12.40	3.73	2.76	16.28	11.39	3.48
T5	PBZ 5 ml	65.09	23.27	3.47	3.37	21.30	16.18	3.68
T6	PBZ 7.5 ml	63.14	28.26	3.23	2.68	17.95	13.21	3.33
T7	Control	83.28	12.93	3.43	3.05	16.03	12.00	3.37
	C.D. (P = 0.05)	5.17	5.72	0.20	0.39	1.40	1.55	NS

Table 3: Effect of growth retardants on various physico-chemical characteristics of litchi cv. Calcuttia.

Treatment	Concentration	Pulp/ Seed ratio	Peel weight (g)	Fruit TSS (%)	Acidity (%)	TSS/ acid ratio	Total sugars (%)	Reducing sugars (%)	Fruit yield (kg)
T_1	CCC 500 ppm	4.46	1.20	18.95	0.60	31.60	16.36	6.35	101.43
T_2	CCC 1000 ppm	4.64	1.37	19.30	0.57	34.00	16.74	7.09	98.27
T_3	CCC 2000 ppm	5.42	1.46	19.96	0.52	38.18	16.30	5.55	98.00
T_4	PBZ 2.5 ml	3.31	1.41	19.43	0.62	31.38	16.60	6.13	100.37
T_5	PBZ 5 ml	4.40	1.49	19.12	0.72	26.57	15.77	5.96	110.38
T_6	PBZ 7.5 ml	3.97	1.41	18.76	0.56	33.90	17.65	7.29	113.95
T_7	Control	3.56	1.42	18.15	0.93	19.60	14.26	7.25	85.18
	C.D. (P = 0.05)	0.82	NS	0.69	NS	3.01	1.86	1.09	2.97

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STUDIES ON GENETIC VARIABILITY, HERITABILITY AND GENETIC ADVANCE IN CUCUMBER (*Cucumis sativus* L.)

Yogesh Chandra Yadav, Sanjay Kumar and Raghvendra Singh

Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi-221 005

E-mail : sanjay123_bhu@yahoo.co.in

ABSTRACT: A field experiment was conducted with 20 diverse genotypes (BSC-1, BSC-2, CH-122, 126,128, CHC-1, Swarna Ageta, VRC-11-2, CC-3, CC-8, DR/NKV/02,VRC-19, CC-2, 4, 5, 6, 7 , 9, 1 and Ranchi-1) in randomized block design with three replications. Analyzed data revealed that among all the genotypes CC-5, BSC-2, BSC-1, CH-128, CHC-2 and CC-2 gave promising results.

Keywords : *Cucumber, heritability, genetic advance, correlation coefficient, path analysis.*

Cucumber is one of the most important cucurbits in India and grown during summer season as well as rainy season. Cucumber is second most widely cultivated cucurbits after watermelon. Its tender fruits are consumed as *salad* and for pickling. It contains protein carbohydrate, iron, phosphorus, vitamin-C and calcium. The fruit and seed possess cooling properties. Fruits are good for people suffering from constipation, jaundice and indigestion (Thambhuraj and Singh, 6). It is cross-pollinated crop and has a wide genetic diversity. Parameters of genotypic and phenotypic coefficient of variation (GCV & PCV) are useful in detecting the amount of variability present in the available genotypes. Heritability and genetic advance help in determining the influence of environment in expression of the characters and the extent to which improvement is possible after selection. The present investigation was, therefore, under taken to ascertain magnitude and extent of genetic variability, heritability and genetic advance, in cucumber.

MATERIALS AND METHODS

The experimental material included 20 diverse entries (BSC-1, BSC-2, CH-122, CH-126, CH-128, CHC-1, Swarna Ageta, VRC-11-2, CC-3, CC-8, DR/NKV/02, VRC-19, CC-2, CC-4, 2 CC-5, CC-6, CC-7, CC-9, CC-1 and Ranchi-1) and were sown in during *rainy* season in the year of 2005-06 in randomized block design with three replications at Vegetable Research Farm, Banaras Hindu University, Varanasi. Row-to-row and plant-to-plant spacings were maintained at 1.5 and 50 cm, respectively. All the agronomic package of practices were adopted to grow a healthy crop in each replication. Randomly 5 plants in each genotype were marked for observation. Observations were recorded on sixteen characters *viz.,* days to 50% germination, days to first male flower anthesis, days to first female flower anthesis, node no. bearing first male flower, node no. bearing first female flower, vine length (m), no. of branches/ vine, nodes no. bearing female flower/ vine, no. of fruits/vine, fruit diameter at edible stage(cm), fruit length at edible stage (cm), fruit weight at edible stage(g), 100- seed weight (g), cavity of fruit at edible stage (cm), days to first harvest and fruit yield / vine. The recorded data were analyzed as suggested by Panse and Sukhatme (5) for analysis of variance. The genotypic and phenotypic coefficient of variance was calculated as per the formula suggested by Burton and De Vane (1) and Johnson *et al.* (2) for heritability and genetic advance.

RESULTS AND DISCUSSION

The mean sum of square was highly significant for all traits, indicating the presence of wide variability in the genotypes (Table 1). Fruit weight at edible stage showed a wide range (97.75-230.43), the minimum and maximum fruit weight at edible stage was recorded in genotypes

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DR/NKV/02 and CC-7, respectively. Days to 50% germination ranged from 3.96 (CH-126) to 5.73 (CC-5), with a mean of 4.84. Days to first fruit harvest and days to first female flower anthesis also registered considerable variability, which ranged from 43.24 (CC-7) to 58.27 (CC-9) and 35.45(CC-7) to 49.55 (CC-9), respectively. Maximum vine length was recorded in VRC-19 and minimum in CHC-1 while maximum and minimum no. of branches/ vine were recorded in CC-5 and CC-3, respectively. The present set of genotypes possessed an average of 3.95 node numbers bearing first male flower, which ranged from 2.91 (Swarna Ageta) to 4.94 (DR/NKV/02), while in case of nodes no. bearing first female flower 4.51 (Swarna Ageta) to 7.60 (CC-6) and its mean value was 6.03. The genotype CC-7 exhibited maximum length of edible fruit (24.94 cm) while it was minimum in CC-1 (13.80 cm). Average no. of fruits/vine showed wide range (7.84-13.80). The minimum and maximum 100 seed weight was recorded in CH-122 and CC-5, respectively. Maximum cavity of fruits at edible stage was recorded in CC-1 whereas, minimum in CC-9, respectively. The maximum and minimum fruit diameter was recorded in BSC-1 and VRC–11-2. Node numbers bearing female flower/vine showed a wide range (9.49-16.25), with maximum and minimum in CC-1 and CHC-1, respectively. Days to first male flower anthesis was recorded maximum in CC-9 and minimum in CC-7, respectively. The minimum and maximum fruit yield/vine was recorded in CC-6 and CC-5, respectively. Results are in accordance with findings of Joshi *et al.* (3) and Mariappan and Pappiah (4).

In general, the phenotypic variance and phenotypic coefficients of variation were higher than the respective genotypic variance and genotypic coefficients of variation for all the traits (Table 2) indicating a considerable influence of environment on their expression. In the present investigation, genotypes were found to possess a high to moderate phenotypic variation for various characters as revealed by PCV. Phenotypic coefficient of variation varied from 6.55% (days to first fruit harvest) to 670.54 (days to first female flower anthesis). The PCV expressed in form of percentage were comparatively high for days to first female flower anthesis followed by node numbers bearing female flower/vine, no. of branches/vine, vine length, fruit yield/vine, days to 50% germination, cavity of fruit at edible stage, node numbers bearing first male flower, numbers of fruits/vine and nodes numbers bearing first female flower. As the estimates of phenotypic variability can not differentiate between the effects of genetic and environmental effects, so the study of genetic variability is effective in partioning out the real genetical differences. Higher the GCV, more the chances of improvement in that characters.

In the present investigation, GCV were comparatively high for days to first female flower anthesis followed by node numbers bearing female flower/vine, cavity of fruit at edible stage, no. of branches/vine, fruit yield/vine, numbers of fruits/vine, fruit length , 100-seed weight, node numbers bearing first male flower and vine length. The GCV was less than the corresponding PCV, indicating the role in the expression of the traits under observation. The difference between GCV and PCV were more in case of days to first female flower anthesis and node numbers bearing female flower/vine. The large difference between GCV and PCV indicated that environmental affects to a large extent the traits. The character having high GCV possessed better potential for further gain and improvement (Burton and DeVane, 1).

Burton and De Vane (1) suggested that GCV together with heritability estimate would give the best option expected for selection. Heritability estimated were high > 90% for days to first male flower anthesis, nodes no. bearing first female flower, vine length, numbers of branches/ vine, no. of fruits/vine, fruit diameter at edible stage, fruit length, fruit weight at edible stage, 100 seed weight, days to first fruit harvest and fruit yield /vine.

High heritability for the characters controlled

Table 1: Range, mean and analysis of variance for different quantitative characters in cucumber.

Characters	Range		Mean	Standard MSS value error		CD (P =0.05)
	Minimum	Maximum				
Days to 50% germination	3.96 (CH-126)	3.73 (CC-5)	484	0.75	1.31**	1.51
Days to first male flower anthesis	33.32 (CC-7)	46.81 (CC-9)	40.06	0.74	2.32**	1.53
Days to first female flower anthesis	35.45 (CC-7)	49.55 (CC-9)	42.50	0.42	503.15**	0.863
Nodes no. bearing first male flower anthesis	2.91 (Swarna Ageta)	4.97 (DR/NKV/02)	3.95	0.39	00.230	0.80
Nodes no. bearing first female flower anthesis	4.51 (Swarna Ageta)	7.60 (CC-6)	6.03	0.49	0.761**	1.05
Vine length (m)	1.45 (CHC-1)	2.68 (VRC-19)	2.06	0.29	0.157	0.59
No.of branches/vine	1.43 (CC-3)	3.20 (CC-5)	2.32	0.11	0.118	0.21
Nodes no. bearing female flower/vine	9.49 (CHC-1)	16.25 (CC-1)	12.87	0.15	72.42**	0.30
No.of fruits/vine	7.84 (Swarna Ageta)	13.80 (CC-5)	10.82	0.32	0.104	0.65
Fruit diameter at edible stage (cm)	2.80 (VRV-11-2)	4.25 (BSC-1)	3.52	0.55	0.161	0.11
Fruit length at edible stage (cm)	13.80 (CC-1)	24.94 (CC-7)	19.37	0.56	1.32**	0.12
Fruit weight at edible stage (g)	97.75 (DR/NKV/02)	230.43 (CC-7)	164.09	0.21	9.58**	0.43
100 seed weight (g)	2.01 (CH-122)	2.98 (CC-5)	2.49	0.14	0.184	0.28
Cavity of fruit at edible stage (cm)	0.20 (CC-9)	0.38 (CC-1)	0.29	0.09	0.464*	0.16
Days to first fruit harvest	43.24 (CC-7)	58.27 (CC-9)	50.97	0.12	2.78**	0.25
Fruit yield /vine	1.41 (CC-6)	2.59 (CC-5)	2.00	0.13	6.71**	0.26

by polygene might be to plant breeder for making effective selection. Moderate heritability (70-80%) are found for node numbers bearing female flower/vine and cavity of fruit at edible stage suggested that the environmental effects constitute a major portion of the total phenotypic variation and hence direct selection for these traits will be less effective. Johnson *et al.* (2) reported that the heritability estimates along with genetic advance is more useful than the resultant effect for selecting the best genotype(s) as it suggest the presence of additive gene effect. High estimate of genetic advance was recorded for days to first female flower anthesis followed by fruit weight at edible stage.

The information on heritability alone may be misleading when used in combination with genetic advance, the utility of heritability estimates increases. In the present study, high genetic advance coupled with high heritability was observed for no. of branches/vine followed by cavity of fruit at edible stage, fruit yield/vine, no. of fruits/vine, fruit length and 100 seed weight. It indicated that additive gene effects were more important for these traits. Therefore, improvement

Table 2: Components of variance, coefficient of variation, heritability, genetic advance as percentage of mean for different quantitative traits.

Characters	Variance		Coefficient of variation		Herit-ability	Genetic advance	Genetic advance as % of mean
	P	G	P	G			
Days to 50% germination	1.87	1.03	20.36	8.43	55.17	0.31	6.72
Days to first male flower anthesis	2.41	2.28	8.75	8.10	94.57	6.48	16.72
Days to first female flower anthesis	1205.91	151.77	670.54	214.53	12.58	1148.78	141.39
Node nos. bearing first male flower anthesis	2.23	2.21	17.52	13.50	99.95	0.94	22.49
Node nos. bearing first female flower anthesis	0.10	0.59	16.21	12.71	56.22	1.23	20.58
Vine length (m)	1.26	1.15	21.97	12.81	99.60	0.33	15.51
No. of branches / vine	1.17	1.16	24.99	18.57	99.57	1.11	48.69
Node nos. bearing female flower / vine	84.41	66.43	497.05	24.32	78.69	0.54	1.46
No. of fruits / vine	7.24	7.14	16.44	16.12	98.66	3.45	32.98
Fruit diameter at edible stage (cm)	0.16	0.16	11.51	11.34	99.98	0.84	22.96
Fruit length at edible stage (cm)	1.32	1.32	15.12	15.02	100.00	5.72	30.93
Fruit weight at edible stage (g)	9.59	9.58	11.26	11.16	99.91	38.84	23.20
100 seed weight (g)	1.81	1.80	15.40	13.77	99.39	0.63	25.14
Cavity of fruit at edible stage (cm)	0.55	0.42	19.26	18.96	76.36	0.11	28.46
Days to first fruit harvest	2.70	2.77	6.55	6.54	99.74	6.60	13.47
Fruit yield /vine	6.73	6.70	21.52	18.53	99.58	0.65	36.60

in these traits would be more efficiently done through selection in the present materials.

Depending upon the variability, heritability and genetic advance estimates, it could be predicted that improvement by direct selection was possible in cucumber for traits like nodes bearing female flowers/vine, no. of branches /vine, node numbers bearing first female flower, node numbers bearing first male flower, 100 seed weight and fruit yield /vine.

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INTEGRATED NUTRITIONAL MANAGEMENT AFFECTS THE GROWTH, FLOWERING AND FRUITING OF REJUVENATED BER

P.N. Katiyar, V.K. Tripathi, R.K. Sachan, J.P. Singh and Ram Chandra
Department of Horticulture
C.S. Azad University of Agriculture & Technology, Kanpur, U.P.-208002

ABSTRACT: The experiment was carried out in the Horticulture Garden of C.S. Azad University of Agriculture & Technology, Kanpur during 2009-11 to investigate integrated nutritional management effects on the growth, flowering, fruiting yield and quality of rejuvenated ber (*Zizyphus mauritiana* Lamk.) cv. Banarasi Karaka. The 35 years old ber plants were headed back with the help of hand saw after leaf fall during mid of May of 2009. There were six treatments of NPK (g) viz., T_1 (200:100:50), T_2 (400:200:100), T_3 (600:300:150), T_4 (800:400:200), T_5 (1000: 500:250), T_6 (Control – No fertilizer and manure) replicated four times in a RBD. Tree under all the treatments barring T6 were supplemented with 50 kg FYM. Fertilizer application through DAP, Urea and MoP was done just after pruning the trees. Application of T_5 promoted vegetative growth but blossoming, fruit set were maximized under T_4 where as the percentage of fruit drop was noted minimum under the lowest level of NPK i.e. T_1. The size and weight of fruit were noted greater under T_4 and smallest size and lesser weight were noted control. The fruit quality was augmented superior in respect of T.S.S., ascorbic acid and lower titratable acidity when the trees were supplemented with 800gN + 400g P + 200gK + 50Kg FYM. The same treatment gave significantly better harvest during first year (30.08 Kg fruits).

Keywords : *Ber, rejuvenation, NPK nutrition, yield, quality.*

Indian jujube (*Zizyphus mauritiana* Lamk.) is an important fruit crop of hot arid ecosystem due to less water requirement, wider adaptability, hardy nature and its ability to flourish well even in inferior soil. So it is known as "King of Arid Fruits". Ber fruit is within the reach of poor people, it is therefore, rightly known as a poor man's fruits. Besides providing the nutritive fruits, various parts of the ber tree possess medicinal value. Ber timber is utilized in the manufacturing of various farm implements and the leaves are good source of cattle feed particularly goats.

Pruning is essential component for the production of quality and quantity fruits, particularly in those fruit crops where fruiting takes place on current season growth. It is also done to avoid tip bearing and making balance between vegetative and reproductive growth. Fruiting in ber occurs in the axil of shoots of current year. Thus the quantum of production depends upon the number and vigour of shoots during current year. The age old ber orchards become heavily infested with weeds, diseases and insect pest and their branches become unproductive, which needs rejuvenation.

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MATERIALS AND METHODS

The experiment was carried out in the Horticulture Garden of C.S. Azad University of Agriculture & Technology, Kanpur during 2009-11 to investigate integrated nutritional management effects on the growth, flowering, fruiting, yield and quality of rejuvenated ber (*Zizyphus* mauritiana Lamk.) cv. Banarasi Karaka. Experimental trees were 35 years old, received uniform cultural operations throughout the experiment. The soil of the field is sandy loam with average fertility having pH of 7.5. Uneconomic ber trees were headed back with the help of hand saw after leaf fall during mid of May of 2009. There were six treatments of NPK (g) viz., T_1 (200:100:50), T_2 (400:200:100), T_3 (600:300:150), T_4 (800:400:200), T_5 (1000: 500:250), T_6 (Control–No fertilizer and manure) replicated four times in a RBD. Tree under all the treatments barring T_6 were supplemented with 50 kg FYM. Fertilizer application through DAP, Urea and MoP was done just after pruning of plants.

Observations regarding growth, flowering, fruiting, yield and quality of fruit were recorded periodically. The diameter and length of fruits and shoots were recorded with the help of vernier calipers and meter scale, fresh fruit weight with the help of electronic balance. Sugar, acidity and ascorbic acid contents of fruit were estimated as per A.O.A.C. (1).

RESULTS AND DISCUSSION

Growth parameters

From the perusal of data (Table 1), it is clear that the growth of shoots influenced significantly by various integrated nutritional management treatments. After pruning ber trees, number of sprouts emerged profusely under each treatment which varied significantly. Treatment T_5 supplied with 1000g N + 500g P + 250g K + 50 kg FYM produced significantly highest number of sprouts-shoots i.e. 56.50 sprouts remaining at par with T_4 (55.50 sprout). Well spaced and vigorous 10 shoots were retained on each tree. Their growth measured in terms of length were recorded 70, 90 and 110 days after heading back indicated that increasing level of fertilizers gave increased length of shoot significantly at all the stages of observations and it was 165, 312 and 512 cm under the maximum level of fertilizer closely followed by its respective lower level (T_4) being significantly at par with T_5. The trees under control obviously expressed poor shoot growth. The diameters of shoots recorded at periodical stages were also noted maximum under T_5. The numbers of secondary and tertiary branches were found significantly greater less than 1000 g N + 500 g P + 250 g K + 50kg FYM (10.5 and 10.9) treatment. All the above vegetative growth parameters of ber sprouts was recorded significantly poor under control.

Nitrogen (N) in optimal dose increased chlorophyll content imparting dark green colour to foliage as it governs to a considerable degree, the utilization of P, K and other elements. Phosphorus (P) closely related with cell multiplication and development, participates in the metabolism of carbohydrate and fat. Similarly potassium (K) might have accelerated enzymes action helping formation of protein and chlorophyll ultimately improving vegetative parameters. Organic manure (FYM) is universally known to improve physical properties of soil by increasing water holding capacity. Similar improvement through fertilizer schedule has been reported in fruit plants (Athani *et al.* 2; Chaudhary and Singh, 3; and Chaudhary *et al.* 4).

Floral and fruiting parameters

Integrated nutritional management after rejuvenation significantly influenced the floral parameters (Table 2). The flower initiation was hastened under control taking 129.55 days after heading back whereas, it was delayed by all the fertilizer treatment in increasing levels with a maximum of 137.80 days. The duration of blossom was longest in T_5 (1000 g N + 500 g P + 250 g K + 50kg FYM) of 11.55 days against the smallest duration (10.45 days) was recorded under control.

Fruit set under the influence of integrated manuring schedule (T_4) indicated 7.65% set followed by its respective higher (7.05%) and lower (6.40%) levels. However, the treatment causing higher fruit set failed to give higher retention and it was maximum under the lowest level (T_1) of fertilization (16.0%). Observations of Athani *et al.* (2) and Singh (8) are in line with the present findings. The size in terms of length and weight of fruit was recorded significantly greater under T_4 (3.99cm, 22.20 g) followed by its respective higher and lower levels. Lighter fruits of smaller size were harvested from control trees (17.90 g and 3.35 cm, respectively). The improvement in size and weight of fruit is obviously due to the optimal integrated nutritional schedule. The findings are in agreement with the reports of Kumar and Kumar (6) and Shyamal (9).

Fruit yield and quality

Yield and quality of fruits are ultimate aim of producer as in the present investigation of

Table 1: Effect of integrated nutritional management on the vegetative growth of rejuvenated ber cv. Banarasi Karaka.

Treatments	No. of sprouts	Retained shoots	Length of shoots(cm) Days after heading back			Diameter of shoots (cm) days after heading back			No. of the branches	
			70	90	110	70	90	110	Secondary	Tertiary
T_1 : 200g N+100g P + 50gK + 50kg FYM	52.5	10	159	282	505	2.34	3.35	4.41	9.15	7.25
T_2 : 400g N+200g P + 100gK+50kg FYM	54.26	10	161	283	459	2.40	3.39	4.45	9.45	7.65
T_3 : 600g N+300g P + 150gK+50kg FYM	54.50	10	164	285	662	2.43	3.40	4.46	9.65	7.75
T_4 : 800g N+400g P + 200gK+50kg FYM	55.5	10	164	302	508	2.56	3.76	4.64	9.75	9.70
T_5 : 1000g N+500g P + 250gK+50kg FYM	56.50	10	165	312	512	2.62	3.93	5.07	10.50	10.90
T_6 : Control	48	10	150	264	443	2.12	3.39	4.44	9.05	7.05
C.D. (P=0.05)	1.76	-	9.26	15.82	35.38	0.07	0.09	0.01	0.5	0.57

Table 2. Effect of integrated nutritional management on the flowering, fruiting, yield and quality of rejuvenated ber cv. Banarasi Karaka.

Treatments	Blossoming after heading back (days)	Duration of blossom	Fruit set (%)	Fruit retention (%)	Size of fruit length (cm)	Weight of fruit (g)	Yield (kg/plant)	T.S.S. (0 Brix)	Ascorbic acid (mg/ 100g)
T_1 : 200g N+100g P + 50gK + 50kg FYM	130.55	11.10	5.70	16.00	3.62	18.35	24.35	14.60	75.45
T_2 : 400g N+200g P + 100gK+50kg FYM	132.15	11.05	6.05	14.00	3.67	19.35	26.45	15.15	78.35
T_3 : 600g N+300g P +150gK+50kg FYM	130.65	11.20	6.40	13.50	3.63	19.10	27.32	15.75	81.50
T_4 : 800g N+400g P +200gK+50kg FYM	133.50	10.50	7.65	14.30	3.99	22.20	30.08	16.41	87.15
T_5 : 1000g N+500g P +250gK+50kg FYM	137.80	11.55	7.05	13.20	3.65	21.30	29.50	15.75	79.25
T_6 : Control	129.55	10.45	6.05	11.15	3.35	17.90	17.75	15.05	74.30
C.D.(P=0.05)	2.31	0.54	0.15	1.19	0.12	1.33	2.42	0.62	1.45

rejuvenation, ber trees yield was improved to the maximum (30.08 Kg/plant) when 800 g N +400g P + 200 g K + 50 kg FYM was applied (Table 2). A decrease in the yield was marked when the doses of NPK were increased. The yield under T_4 and T_5 were increased by 69.46 and 66.19% over control, respectively.

Chemical composition of fruits is also one of the most important parameters deciding their quality and marketability. During present investigation, application of 800g N+400g P + 200g K along with 50 kg FYM per tree enhanced the T.S.S. content to the tune of 16.41°Brix, lowering the acidity contents (0.21%) in fruits and increasing vit C contents (87.15 mg). Results are in consonance with Ghosh (5) and Pereira and Mitra (7).

Therefore, most superior fruits could be harvested when 800g N+ 400g P+ 200g K+50kg FYM tree was applied. An increase in N, P & K dose i.e. 1000g N+500g P+250g K in association with 50kg FYM brought about a slight deterioration in the quality traits i.e. 15.75°Brix T.S.S. and 81.50 mg/100 mg vit-C content. The fruits produced under lowest levels of N, P & K nutrients along with 50 kg FYM (200g N+100g P+50g K +50 Kg FYM), exhibited lesser T.S.S. and ascorbic acid, which were comparable to control. Thus, T_4 (800 g N+400 g P+200g K+50 kg FYM) proved optimal treatment for improving fruit quality as it improved T.S.S. and vit. C contents by 9.10% and 17.29% over control and reduced acidity at the same time by 0.22%.

Improvement in yield and quality of ber fruits may be attributed due to the optimal amount of NPK under agro-climatic conditions prevailing in North Gangetic Plains of the Country. Findings are in accordance with Chaudhary and Singh (3), Chaudhary *et al.* (4), Kumar and Kumar (6) and Shyamal (9).

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ECOFRIENDLY MANAGEMENT OF STEMPHYLIUM BLIGHT (*Stemphylium botryosum*) OF GARLIC BY PLANT EXTRACT AND BIOAGENTS

Upesh Kumar[1], Prem Naresh and S.K. Biswas

Department of Plant Pathology, C. S. Azad University of Agriculture & Technology, Kanpur

[1]K.V.K., Sehore (M.P.)

ABSTRACT: *In vitro* screening of six extract of plant species viz. *Azadirachta indica*, *Datura metel, Lantana camara, Parthenium hystorophorus, Ociumum spp., Argimone mexicana* and five bioagents viz. *Trichoderma harzianum, T. viride, Aspergillus niger, Penicillium citrinum* and *Gliocladium virens* were tested against *Stemphylium botryosum.* Among plant extracts *Azadirachta indica* (66.5 per cent) and *Datura metel* (64.5 per cent) were the best in restricting the growth of pathogen over control and in evaluation of bioagents, *S. botryosum* + *T. harizianum* (81.2 per cent) and *S. botryosum* + *T. viride* (74.5 per cent) were significantly inhibited the growth of pathogen. Under field condition suppression of pathogen by *T. harzianum*, treating the garlic cloves (0.2 per cent) along with two foliar sprays (0.2 per cent) at 15 days interval found to be most effective for management of this disease.

Keywords : *Garlic, blight, plant extract, bioagent.*

Garlic (*Allium sativum* L.) is an important of both vegetarian and non vegetarian people with spicy use. It possesses medicinal value too. Due to presence of volatile oil and other sulphur compound it has antiseptic and antibiotic action. Garlic is the second most widely cultivated crop after onion. It is regarded as one of the important bulb crop grown and used as spice or condiment through out India (Singh and Srivastava, 7). India ranks second in world's total area under garlic and third in production. Madhya Pradesh is the leading state in India with around 30 per cent of both area and production (Tambi *et al.*, 8).

Garlic is affected by several fungal diseases such as purple blotch, downy mildew, smut, black mould, and *stemphylium* blight. Out of them, *Stemphylium* blight is an important disease of garlic crop. Incidence of this disease is ranged between 5.0-43.2 per cent (Jakhar *et al.* 4). Since garlic is consumed from green leaf to dried mature cloves and the use of chemical is being discouraged, now a day for the reason that the fungicides are not ecofriendly for being hazardous to mammalian group and responsible for creating the environmental pollution in air, soil and water. Therefore, keeping in view the damage and wide spread occurance of the disease, plant extract and bioagent against this pathogen *in vitro* and *in vivo* were tested for ecofriendly management of this disease.

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MATERIALS AND METHODS

Isolation of the pathogen and pathogenicity test

The leaf spot and lesion showing the initial and distinct characteristic symptom were selected for isolation of pathogen. Naturally infected leaves showing the characteristic symptom of *Stemphylium* leaf blight collected from infected field of garlic and maintained in P.D.A. (Potato Dextrose Agar) medium.

Collection and maintenance of antagonist

The antagonistic bioagent available in Department of Plant Pathology, C.S. Azad University of Agri. & Tech., Kanpur were utilized in present study. All antagonist then incubated for 48 h at 28 ± 1°C. The culture of both bacterial and fungal antagonists were then preserved in refrigerator and periodic transfer was made for their maintenance.

I. *In vitro* evaluation of plant extracts

The relative efficacy of six plants extracts viz. *Azadirachta indica, Datura metel, Lantana camara, Parthenium hystorophorus, Ociumum spp.* and *Argemone maxicana* were tested against the pathogen in laboratory. Fresh and healthy leaves of all six test plants were collected from the surrounding University field for the preparation of plant extract. The leaves were first washed under running tap water to remove dust material adhering to surfaces and then in distilled water. One hundred grams (100 g) leaves from each sample were then ground with sterile water (100 ml) at 1:1 w/w in a pistal and mortar. After thorough grinding the extract was filtered through muslin cloth and then through Whatman filter paper no1. Later the extract was passed through seive filter to free them from bacterial contamination. The extract is then used as standard plant extract solution of 100 per cent concentration of 1:1 ratio. Prepared plant extract was treated at 60°C for 15 minutes for destruction of other microorganism contamination. Five ml of each extract was incorporated in sterilized molten 100 ml of P.D.A. medium and poured into sterilized petri plates (20 mm in size). Each treatment having three replications were maintained and allowed to solidity. A circular disc of 5 mm diameter was taken from 15 days old culture of the pathogen, cut by sterilized cork borer and placed in the centre of each petri plate containing solidified plant leaves extract. The plants were incubated at 25 ± 1°C. The efficacy of plant leaves extract were assessed by measuring the growth of calony diameter in mm and interpreted in per cent inhibition over control. The per cent inhibition over ontrol was calculated by formula reported by Bliss (2).

$$\text{Per cent inhibited over control} \quad \frac{C \quad T}{C} \quad 100$$

Where,

C=Growth of fungus in control

T=Growth of fungus in treatment

II. *In vitro* evaluation of bioagents

Five bioagents viz. *Trichoderma harzianum, T. viride, Aspergillus niger*, *Penicillium citrinum* and *Gliocladium virens* were tested *in vitro* against pathogen and the culture media devised of any bioagents served as control. Five mm disc of test fungus was placed before 72 hours of bioagent placement on P.D.A. (Potato Dextrose Agar) medium in petri-plates. The test fungus and bioagents were placed opposite to each other at a distance of 5 mm from the periphery. Each treatment was replicated three times and incubated at 25 ± 1°C. The data were recorded after 96 hours at bioagents placement, when the inhibition zones were formed and expressed as per cent inhibition. The percentage of inhibition of pathogen was calculated by the formula of Bliss (2).

Table 1: Effect of plant leaf extracts on calony growth of *S. botryosum in vitro.*

S. No.	Leaf extract (Treatment)	Average calony growth	Per cent inhibition over control
1.	*Azadirachta indica*	29.4	66.5
2.	*Datura metel*	31.2	64.5
3.	*Lantana camara*	34.8	64.5
4.	*Parthenum hysterophorus*	52.0	40.8
5.	*Ociumum* sp.	63.5	27.7
6.	*Argimone maxicana*	68.6	2.9
7	Control	87.8	-
	CD (P=0.05)	2.57	-

III. Evaluation of effective bioagents in field

The most effective bioagent in laboratory evaluation were employed for clove treatment and also for foliar spraying when the appearance of diseases. The susceptible variety of garlic G-15 was sown on 16th October. Three replications were kept for each treatment and untreated cloves sown similarly served as control. Observations were recorded at fortnightly interval.

RESULTS AND DISCUSSION

I. *In vitro* effect of plant extract

The results presented in Table 1 show that out of six plant extracts, *Azadirachta indica* (66.5 per cent inhibition over control) statistically at par with *Datura metel* was proved to be most effective for inhibiting fungal growth. The next in superiority was *D. metel* extract which gave 31.2 mm radial growth and 64.5 per cent inhibition over control. Prasad and Barnwal (6) also evaluated that effect of leaf extract of *Azadirachta indica, Pongomia pinnata, Datura metel, Ociumum sanctam (O. tenuitisum), Eucalyptus citriodera and Mentha arvensis* on *Stemphylium* blight of onion (cv. N-53) in field trial. Datar (3) reported that, maximum reduction of purple blotch on onion caused by *Alternaria pori* was observed with leaf extract of *Polyanthia longifolia* followed by *Eucalyptus citriodera, Datura alba, Ipomea carmea, Tridax procumbens and Tabernemontana coronaria* under field conditions.

Table 2: Effect of the bioagents on the growth of *S. botryosum in vitro.*

S.No.	Leaf extract (Treatment)	Average diameter of fungal calony (mm)	Per cent inhibition over control
1.	*Stemphylium botryosum + Trichoderma harzianum*	16.5	81.2
2.	*S. botryosum + T. viride*	22.4	74.5
3.	*S. botryosum + Aspergillus niger*	27.8	68.3
4.	*S. botryosum + Penicillium citrinum*	32.6	62.9
5.	*S. botryosum + Gliocladium virens*	37.4	57.4
6.	Control	87.8	-
	CD (P=0.05)	1.81	-

II. *In vitro* evaluation of bioagents

Table 2 showed that out of five bioagents, the maximum (81.2 per cent) colony growth inhibition of *Stemphylium botryosum* was in *T. harzianum* (Kanpur isolates) followed by 74.5, 68.3, 62.9 and 57.4 per cent in *T. viride* (Kanpur isolate), *A. niger* (Delhi isolate), *P. citrinum* (Lucknow isolate) and *G. virens* (Pantnagar isolate), respectively. The radial growth of the pathogen ranged between 16.5 mm (*T. harzianum*) to 37.4 mm (*G. virens*). Montensions *et al.* (5) also reported on screening of bacterial antagonists against *Stemphylium vesicarium in vitro* of 2 + 7 strain of *Pseudomonos flurescens,* 21 strains inhibited the growth of *Stemphylim vesicarium.*

III. Effect of bioagents (Cloves treatment and foliar spray) against disease and yield of garlic *in vivo*

It is evident from Table 3 that all the treatments including control were statistically different with each other. The minimum disease infestation was recorded on clove treatment (0.2 per centt) plus two foliar spray of *Trichoderma harzianum* (18.5 per cent) and 19.2 per cent during 2003-04 and 2004-05, respectively. Minimum increase in yield over control was observed in this treatment proving thereby its superiority in efficacy. Barnwal *et al*. (1) have also reported the efficacy of *P. fluorescens* and hexacenozole against *Stemphylium botryosum* causing blight in onion. All the treatments reduced severity of disease as

Table 3: Effect of bioagent by cloves treatments and foliar spray against disease and yield of garlic in vivo.

S. No.	Treatment	Average disease intensity (%)			Average yield (q/ha)			Increase in yield over control (%)		
		2003-04	2004-05	Aver-age	2003-04	2004-05	Aver-age	2003-04	2004-05	Aver-age
1.	Clove treatment	32.00 (34.43)	30.80 (33.68)	31.40 (34.06)	97.20	99.80	98.50	14.10	15.00	14.55
2.	Clove treatment + single foliar spray	27.20 (31.41)	26.40 (30.89)	26.80 (31.15)	108.50	110.00	109.25	27.30	26.70	27.00
3.	Clove treatment + two foliar sprays	18.50 (25.47)	19.20 (25.99)	18.85 (25.73)	116.40	115.80	116.10	36.60	33.40	35.00
4.	Control	48.00 (43.85)	45.80 (42.58)	46.90 (43.22)	85.20	86.80	80.00	-	-	-
	C.D. (P=0.05)	3.52	4.30	-	12.42	15.85	-	-	-	-

compared to control with hexaconazale treatment resulting good crop yield and lower disease severity as compared to *P. fluorescens.*

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EVALUATION OF BARAMASI LEMON GERMPLASM UNDER PUNJAB CONDITIONS

S.K. Jawandha, Nav Prem Singh, P.P.S. Gill and Karnail Singh[1]

Department of Horticulture, PAU, Ludhiana

[1]Deptt. of Plant Breeding and Genetics,

E-mail skjawandha@pau.edu

ABSTRACT: Baramasi lemon plants are common found growing in various agro-climatic zones including sub mountainous tract of Punjab and chance for the selection of elite strains are high due to wide genetic diversity in the exiting germplasm. To assess the genetic variability in baramasi lemon, the fruit samples collected and analysed for various physic-chemical attributes. A wide range of variability with respect to fruit attributes like fruit weight, rind thickness, vitamin C content and number of segments have been recorded. This variability may possibly be exploited for the selection of superior genotypes for conservation, evaluation, utilization and a source for crop improvement in future breeding programme under sub tropical conditions.

Keywords : *Baramasi lemon, genetic diversity, fruit size, fruit quality.*

Citrus is one the widely grown fruit in India. Out of various citrus fruits, limes and lemons are third most important fruits. Barmasi lemon, an indigenous variety of lemon is generally grown in India due to greater adaptability, high yield and tolerance to citrus canker disease as compared to kagzi lime. These are known to posses curative value for certain diseases of bones and joints, bilious diseases, prevention of capillary bleeding, piles, dysentery, cold, influenza, constipation and scurvy (Dhillon, 5). Baramasi lemon is heterozygous in nature and thus exhibits wider variability in seedling population. Introduction and selection is one the most widely used breeding method in citrus which involves identification of promising types from the present population. The superior chance seedlings can be selected as variety/strain after their evaluation under particular agro-ecological zone. Baramasi lemon is found growing naturally in sub-mountainous area of Punjab as scattered plantation in various parts of North India. Importance of clonal selections in crop improvement is well recognized by earlier workers (Badge and Patil, 3, Badiyala *et al*. 4). So, it is essential to identify superior strains of Baramasi lemon for thier collection, conservation, evaluation and utilization in the future breeding programmes.

MATERIALS AND METHODS

To assess the genetic variability in baramasi lemon, the fruit samples collected from different growing zones of Punjab during a state level Citrus Show were analysed for various physico-chemical attributes viz; fruit size, fruit weight, peel thickness, number of articulates, number of seeds, juice percentage, total soluble solids, total titratable acid content and vitamin C content. Fruit size (Length Breadth) and rind thickness were estimated with the help of digital Vernier Calliper. Juice content was estimated by extracting juice from the pulp by citrus juice extractor and juice percentage was worked out on fresh fruit weight basis. The extracted juice was strained through a muslin cloth and total soluble solids were noted with Bausch and Lamb hand refractometer in term of degree brix (%) and values were corrected at 20°C. Juice acidity was estimated by titrating 10 ml juice against 0.1 N NaOH using phenolphthalein as indicator and ascorbic acid by titration against 2, 6 dichlorophenol indophenol dye (AOAC, 1).

RESULTS AND DISCUSSION

The data pertaining to physico-chemical attributes of Baramasi lemon depicted a high degree of variability with respect to fruit morphology and quality characteristics (Table 1). The fruit size is a market governing factor for Baramasi lemon especially in the winter crop when the size of fruit extends too large. Among the

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Table 1: Fruit quality characteristics of different Baramasi lemon strains.

Entry No.	Fruit wt. (g)	Fruit length (cm)	Fruit breadth (cm)	Peel thickness (mm)	TSS(%)	Acidity (%)	Juice content (%)	No. of articulate	Vit. C (mg/100 g)
3855	52.5	4.67	4.72	2.9	8.8	5.4	38.0	14	65.26
3853	86.3	5.37	5.45	3.2	7.8	5.8	37.8	13	73.50
4790	61.3	5.75	4.60	2.3	7.0	4.9	34.1	13	68.00
5643	51.7	5.80	4.16	2.9	8.5	7.3	39.5	11	65.26
5676	55.0	4.80	4.60	2.3	8.1	6.7	47.6	12	25.28
5631	55.0	4.83	4.66	2.1	8.4	6.9	46.5	12	36.45
5642	90.0	5.75	5.50	2.5	8.0	7.2	29.7	13	54.68
6124	60.0	4.97	4.83	2.3	8.8	6.5	37.1	13	47.62
5635	71.6	5.78	5.03	3.0	7.8	5.7	37.0	11	54.09
847	75.0	5.47	5.00	2.4	8.0	6.7	54.6	11	38.80
2339	76.7	5.33	5.32	3.0	7.9	5.9	41.7	18	64.68
5481	58.8	5.15	4.60	2.1	7.4	6.4	44.8	11	55.80
6122	56.3	4.97	4.75	2.2	8.2	6.0	52.7	13	64.68
6002	113.3	6.87	5.90	4.1	8.4	4.7	36.9	13	43.51
5649	78.3	5.73	5.33	2.9	8.6	5.8	44.5	14	53.50
3994	111.7	6.50	5.90	2.6	7.8	5.4	48.0	14	56.10
5673	50.0	4.67	4.50	2.4	8.8	7.4	46.0	13	52.60
6000	95.0	6.00	5.70	4.0	7.5	4.9	35.6	13	56.20
6193	96.7	5.60	5.70	3.3	7.9	6.6	37.7	15	53.50
5447	53.8	4.80	4.55	2.2	8.2	6.0	39.9	13	44.30
4680	53.3	4.53	4.77	2.4	7.8	5.9	37.1	15	67.62
5672	51.3	4.77	4.50	2.0	8.4	6.6	41.9	12	75.85
5946	83.3	5.60	5.30	2.8	8.6	5.0	44.3	13	75.34
5732	56.6	5.23	4.67	2.4	8.1	4.8	43.2	12	50.56
5665	80.0	5.33	5.20	2.9	8.0	5.8	41.0	13	42.92
5641	80.0	5.17	5.50	2.6	7.5	5.7	47.3	14	58.80
3996	100.0	5.90	5.76	3.3	8.1	5.2	46.0	13	50.56
5669	63.3	5.20	4.93	2.6	7.5	4.8	36.7	13	69.39
6191	68.3	4.90	5.20	2.3	7.6	6.1	47.1	15	79.48
5735	66.6	6.73	4.67	2.5	7.9	5.4	36.5	12	49.39
1690	58.3	5.13	4.77	2.6	7.5	5.1	32.2	12	92.91
6196	70.0	5.20	5.13	2.4	7.3	5.7	40.5	14	63.50
2285	157.5	6.80	6.60	3.2	7.2	5.5	42.1	11	53.60
6123	58.3	4.83	4.83	2.4	8.0	6.5	40.8	11	55.27
5731	78.3	5.70	5.35	1.9	7.6	4.8	37.3	13	36.45
6126	34.0	4.08	4.04	2.0	8.6	6.4	43.4	11	80.40
1147	58.7	5.20	4.75	3.0	8.0	5.6	43.1	11	43.51
Average	72.08	5.38	5.05	2.66	7.99	5.87	41.36	12.84	57.28
CV (%)	31.78	11.76	10.50	18.81	5.76	12.70	12.90	11.38	24.35

Table 2: Baramasi lemon showing matrix of correlation coefficients between different physio-chemical attributes.

	Fruit weight	Fruit length	Fruit breadth	Peel thickness	TSS	Acidity	Juice content	No. of articulate	Vitamin C content
Fruit weight	1.00	0.790**	0.958**	0.622**	-0.344*	-0.334*	0.052	0.138	-0.177
Fruit length		1.00	0.68**	0.59**	-0.299	-0.418*	0.200	-0.042	-0.231
Fruit breadth			1.00	0.62**	-0.351*	-0.378*	0.049	0.311	-0.141
Peel thickness				1.00	-0.080	-0.346*	-0.238	0.128	-0.055
TSS					1.00	0.395*	0.204	-0.054	-0.129
Acidity						1.00	0.251	-0.143	-0.138
Juice content							1.00	-0.068	-0.228
No. of articulate								1.00	0.19
Vitamin C									1.00

**Significance at 0.01level

* Significance at 0.05 level

various parameters the maximum variability was noted in fruit weight (31.78%) followed by vitamin C content (24.35%), peel thickness (18.81 %) and juice content (12.90%). In different evaluated strains, fruit weight varied from 34.0 g to 157.5 g. Fruit length and breadth indicates the size and shape of fruit. Similarly, the significant variation in length (4.08 to 6.80 cm) and breadth (4.04 to 6.60 cm) was noted in evaluated fruit samples. A great variability was also recorded in peel thickness which ranged from 1.9 to 4.1 mm. However, a moderate variation in number of articulates per fruit was recorded which ranged from 11 to 15. Citrus fruits are generally used for juice purposes and their acceptability depends upon the juice content present in the fruit especially in the lime and lemon. A wider range (29.7 - 57.0 %) in juice content was recorded among the evaluated samples. The biochemical properties of fruits were observed in terms of total soluble solids, fruit acidity and vitamin C content and recorded variability of 7.0 to 8.8 % 4.7 to 6.9 per cent and 25.28 mg/100g to 80.40 mg/100g, respectively. The present findings indicate that the strains can be selected from seedling population on the basis of fruit weight, vitamin C content and rind thickness. Fruit weight exhibited a significant positive correlation with fruit length (0.79), fruit breadth (0.96) and peel thickness (0.63) (Table 2). In the evaluated strains number of articulates, TSS, acidity and vitamin C content showed non significant correlation with fruit weight. Similar variation in fruit characters in lemon cultivars was reported by Arora and Daulta (2), Fallahi *et al.* (6) and Prasad *et al.* (7). This variability may possibly be exploited for the selection of superior genotypes for conservation, evaluation, utilization and a source for crop improvement in future breeding programme under sub-tropical conditions. The plants of Baramasi lemon having desired fruiting attributes can be raised after the collection of bud sticks from the identified entries.

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EFFECT OF BIO-REGULATORS ON GROWTH AND YIELD PARAMETERS OF *CAPSICUM* CULTIVARS UNDER CONTROLLED CONDITION

R.N. Singh, S.L. Pal[1], D.K. Rana[1], S.S. Rawat and M.S. Gusain

Department of Horticulture, Chauras Campus, HNB Garhwal University, Srinagar (Garhwal) 246 174, Uttarakhand, India.

[1]Deptt of Horticulture, R.S.M. College, Dhampur (Bijnor) U.P.

ABSTRACT : The investigation was carried out to study the effect of bio-regulators on growth and yield parameters in *capsicum* under protected condition in Garhwal region. The investigation revealed that bio-regulators spray had significant influence on growth and yield. Spraying of NAA @ 50ppm increased the plant height, number of secondary branches, leaf area, days taken for anthesis, number of flowers/plant, number of fruits/plant, fruit weight and yield per plot. The maximum height (114.38 cm) and maximum yield (1.85 kg) per plant was found in treatment T_3.

Keywords : *Capsicum, bio-regulators, growth, yield, controlled environment.*

Capsicum (*Capsicum annuum* var. *grossum* L.), also called as bell pepper, belonging to the family Solanaceae, is one of the most popular and highly valued vegetable crop grown in tropical and sub-tropical parts of the world. It is believed to be the native of tropical South America (Sheomaker and Tesky, 9). Growing of capsicum under controlled condition has been reported to give high productivity of good quality produce in developed countries. Hence, there is a need for evaluating the performance of capsicum under controlled condition for getting higher productivity of excellent quality under Indian condition. Bio-regulators play an important role in growth and development of any crop including capsicum. Since no much information of sweet pepper with respect to varying levels of bio-regulators, there is an imminent need to assess the optimum levels of bio-regulators for its cultivation in controlled condition. Therefore, this experiment was carried out to study the effect of bio-regulators on growth and yield parameters of capsicum cultivars under controlled condition in Garhwal region.

MATERIALS AND METHODS

The investigation was carried out using capsicum cultivars viz., California Wonder (V_1) and Solan Bharpur (V_2) under controlled condition, HNB Garhwal University, (Garhwal), Uttarakhand during 2011. Field experiments were conducted during January 2011 to June 2011 and a plot size of 2x1.25 m was followed. Lay out was prepared by using randomized block design with three replications and treatment details were IAA at 100 ppm (T_1), IAA at 200 ppm (T_2), NAA at 50 ppm (T_3), NAA at 100 ppm (T_4), 2,4-D at 5 ppm (T_5), 2,4-D at 10 ppm (T_6), GA_3 at 25 ppm (T_7), GA_3 at 50 ppm (T_8), GA_3 25+NAA 50 ppm (T_9), $GA_3$50+NAA 100 ppm (T_{10}) and control (T_{11}). Seedling of 40 days old was transplanted on March 2nd, 2011 at the spacing of 40x35 cm and the recommended dose of N: P: K at 100: 80: 80 kg was applied. The quantity of fertilizers was calculated to the area of plot and the half N and entire P and K was applied as basal dose and the remaining N was applied as top dressing. Freshly prepared aqueous solution of IAA, NAA, 2, 4-D and GA_3 was sprayed two times on flower cluster of plant. First and second spraying were done at flower initiation and 20 days later from the first spray, respectively. Observations on growth and yield were recorded and mean value was subjected to statistical analysis (Snedecor and Cochran, 11).

RESULTS AND DISCUSSION

The results of the growth characters (Table 1) indicated that the different treatments have significant influence on growth characters. The maximum plant height was found in treatment with NAA at 50 ppm (T_3) in both cultivars of capsicum viz., California Wonder and Solan Bharpur (114.38

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cm and 111.66 cm, respectively). These results are similar to the findings of Thapa *et al.* (12) in chilli. The maximum number of secondary branches per plant was observed under treatment NAA at 50 ppm (T_3) in both cultivars of capsicum viz., California Wonder and Solan Bharpur (13.33 and 11.33, respectively). The experimental findings are according to the previous findings of Balraj *et al.,* (1) in chilli. The maximum leaf area was observed under treatment NAA at 50 ppm (T_3) in both cultivars of capsicum viz., California Wonder and Solan Bharpur (13.41 cm^2 and 12.38 cm^2, respectively). These results are confirmed the findings of Joshi and Singh (4) in chilli.

In respect to the yield parameters (Table 1, 2 and 3), the minimum number of days taken for first flower was observed in NAA at 50 ppm (T_3) in both cultivars of capsicum viz., California Wonder and Solan Bharpur (41.10 days and 41.66 days, respectively). These results are confirmed with the findings of Laxman and Mukharjee (6) in chilli. The maximum number of flowers per plant was found in treatment NAA at 50 ppm in both cultivars of capsicum viz., California Wonder and Solan Bharpur (63.11 and 57.21, respectively). These results are similar to the findings of Jayananadam and Bavaji (3) in chilli. The maximum number of fruits per plant was found in treatment NAA at 50 ppm in both cultivars of capsicum viz., California Wonder and Solan Bharpur (35.44 and 32.77, respectively). These results are similar to the findings of Gutam *et al.* (2). The minimum number of days taken for 50 per cent plant to flower was found in treatment NAA at 50 ppm in both cultivars of capsicum viz., California Wonder and Solan Bharpur (51 days and 51.33 days, respectively). These results are similar to the findings of Shetty *et al.* (8). The maximum fruit set per cent was found in treatment NAA at 50 ppm in both cultivars of capsicum viz., California Wonder and Solan Bharpur (57.69 and 57.70, respectively). These results are similar to the findings of Shetty and Manohar (7).

The minimum number of days taken for first picking was observed in NAA at 50 ppm (T_3) in both cultivars of capsicum viz., California Wonder and Solan Bharpur (58.66 days and 58.99 days, respectively). These results confirmed the findings of Singh (10). The maximum duration of marketable fruits was found in treatment NAA at 50 ppm in both cultivars of capsicum viz., California Wonder and Solan Bharpur (28.99 days and 29.33 days, respectively). These results are similar to the findings of Singh (10). The maximum weight of fruit was found in treatment NAA at 50 ppm (T_3) in both cultivars of capsicum viz., California Wonder and Solan Bharpur (52.53 g and 39.21 g, respectively). These results are similar to the findings of Trivedi (13) in chilli. The maximum yield per plant was found in treatment NAA at 50 ppm in both cultivars of capsicum viz., California Wonder and Solan Bharpur (1.85 kg, and 1.26 kg respectively). These results are similar to the findings of Kannan *et al.* (5). The maximum yield per plot was found in NAA at 50 ppm.

The maximum number of seed per fruit was found in treatment NAA at 50 ppm (T_3) in both cultivars of capsicum viz., California Wonder and Solan Bharpur (223.33 and 197.66, respectively). These results are similar to the findings of Gutam *et al.* (2). The maximum weight of 1000 seed was found in treatment NAA at 50 ppm in both cultivars of capsicum viz., California Wonder and Solan Bharpur (9.82 g and 10.66 g, respectively). The similar finding was also reported by Uniyal (14).

The maximum fruit length was found in treatment NAA at 50 ppm (T_3) in both cultivars of capsicum *viz*., California Wonder and Solan Bharpur (6.96 cm and 6.91 cm, respectively). The experimental finding was confirming the findings of Trivedi (13) in chilli. The maximum fruit breadth was found in treatment IAA at 100 ppm (T_1) in both cultivars of capsicum *viz*., California Wonder and Solan Bharpur (6.30 cm and 6.83 cm, respectively). The experimental results supported the findings of Trivedi (13) in chilli.

The investigation on effect of bio-regulators on growth and yield of capsicum cultivars viz., California Wonder and Solan Bharpur under controlled condition revealed that the

Table 1: Effect of bio-regulators on growth and yield parameters of *Capsicum.*

Treatments	Plant height (cm)		Number of secondary branches per plant		Leaf area (cm^2)		Days taken for first flower		Number of flowers per plant		Number of fruit per plant	
	V_1	V_2	V_1	V_2	V_1	V_2	V_1	V_2	V_1	V_2	V_1	V_2
T_1	98.33	102.22	10.66	9.66	12.65	12.11	41.66	41.77	49.33	48.21	24.77	23.77
T_2	96.88	100.55	10.33	8.33	11.55	11.88	41.87	41.98	51.77	50.66	24.33	23.55
T_3	114.38	111.66	13.33	11.33	13.81	12.38	41.1	41.66	63.11	57.21	35.44	32.77
T_4	103.05	110.27	12.33	10.66	12.44	11.98	41.67	41.88	56.99	55.66	32.88	30.44
T_5	88.05	88.94	10.00	7.33	6.23	5.88	42.66	42.11	46.66	44.66	22.77	19.88
T_6	76.11	72.77	9.00	7.66	7.6	7.07	42.55	42.33	45.44	42.88	22.1	20.1
T_7	86.38	97.22	6.66	6.33	10.5	10.11	53.44	53.99	45.99	47.33	22.88	23.99
T_8	101.44	100.55	8.66	6.33	10.82	9.78	53.66	54.11	47.1	48.11	23.55	24.11
T_9	98.33	99.16	7.66	7.66	8.57	9.4	46.11	44.33	46.88	47.99	23.44	23.77
T_{10}	97.22	95.83	8.33	5.66	7.97	6.53	45.55	44.32	46.22	49.99	24.33	24.77
T_{11}	86.94	85.33	6.00	5.00	5.7	5.00	43.66	43.33	42.66	43.11	20.55	19.44
C.D. (P=0.05)	19.17	16.68	2.37	1.65	3.92	4.07	2.79	1.32	2.79	6.52	2.01	3.12

Table 2: Effect of bio-regulators on yield parameters of *Capsicum.*

Treat-ments	Days taken for 50 per cent plants to flower		Fruit set per cent		Days taken for fruit set		Days taken for first picking		Duration of marketable fruit		Fruit weight (g)	
	V_1	V_2	V_1	V_2	V_1	V_2	V_1	V_2	V_1	V_2	V_1	V_2
T_1	51.33	52.44	49.48	49.75	8.88	8.77	59.22	63.33	27.1	24.55	47.81	37.8
T_2	52	52.66	49.35	49.3	9.33	8.99	60.66	61.44	28.88	26.33	49.27	33.88
T_3	51	51.33	57.69	57.7	8.44	7.99	58.66	58.99	28.99	29.33	52.53	39.21
T_4	51.66	52.33	56.2	54.65	8.55	8.66	59.1	59.55	28.55	28.66	51.75	37.8
T_5	52.66	52.33	48.78	45	10.1	9.55	67.1	68.44	18.33	18.22	28.7	30.05
T_6	54.66	55.66	48.77	46.77	9.66	9.77	67.66	71.88	14.77	16.55	27.12	29.52
T_7	63.66	64.66	49.77	47.46	9.99	8.88	72.1	71.22	18.88	17.99	33.67	35.93
T_8	64.33	62.33	49.95	50.31	9.55	9	74.55	73.66	20.11	16.99	33.2	36.6
T_9	56.66	55.33	50	49.64	9.44	8.99	71.77	69.66	17.55	18.33	33.5	31.62
T_{10}	55	54	51.87	49.55	9.88	9.44	69.66	72.33	19.22	17.55	45.3	36.41
T_{11}	62.33	62.38	47.99	44.59	10.44	10.44	67.99	67.66	19.22	18.44	38.45	26.69
C.D. (P=0.05)	7.84	4.99	3.16	5.5	0.63	0.77	3.05	3.26	2.83	2.66	8.02	4.29

Table 3: Effect of bio-regulators on yield and quality parameters of Capsicum.

Treatments	Yield per plant (kg)		Yield per plot (kg)		Number of seeds per fruit		1000 seed weight (g)		Fruit length (cm)		Fruit breadth (cm)	
	V_1	V_2	V_1	V_2	V_1	V_2	V_1	V_2	V_1	V_2	V_1	V_2
T_1	1.12	0.73	20.22	13.29	212.1	188.88	9.56	9.8	8.06	6.98	4.6	4.99
T_2	1.19	0.78	21.42	14.28	202.44	147.99	9.39	9.14	5.2	6.62	5.23	5.67
T_3	1.85	1.26	33.06	22.8	223.33	197.66	9.82	10.66	6.96	6.91	6.3	6.83
T_4	1.67	1.11	26.64	21.84	220.21	196.66	9.57	10.42	6.85	6.45	6.17	6.29
T_5	0.71	0.57	12.71	10.26	177.99	180.77	9.33	9.77	4.44	5.25	4.26	3.94
T_6	0.61	0.56	13.26	11.82	196.33	147.99	9.66	9.5	4.35	4.18	4.14	3.77
T_7	0.68	0.83	12.54	15	67.99	88.1	8.77	8.49	5.75	5.48	4.61	5.14
T_8	0.9	0.87	12.27	15.81	68.77	69.33	8.78	9.21	5.43	5.26	5.21	5.57
T_9	0.92	0.74	15.9	13.32	201	185.99	9.56	9.67	5.9	5.43	4.82	4.95
T_{10}	1.11	0.88	20.1	16.02	207.33	94.44	9.2	9.71	5.98	6.09	5.21	4.93
T_{11}	0.57	0.52	11.1	9.36	116.44	100.44	9.1	8.9	6.06	5.2	5.03	4.56
C.D. (P=0.05)	0.22	2.85	4.46	3.07	56.32	39.97	0.74	0.77	1.12	0.93	18.46	0.75

bio-regulators spray had significant influence on growth and yield. Spraying of NAA at 50 ppm significantly increased the plant height, number of secondary branches, leaf area, days taken for first flower, number of flowers/plant, number of fruits/plant, days taken for 50 per cent plants to flower, fruit set per cent, days taken for fruit set, days taken for first picking, duration of marketable fruit, fruit weight, yield/plant, yield/plot, yield/hectare, number of seed/fruit, 1000 seed weight, and fruit breadth, while fruit length increased in IAA at 100 ppm. This experiment shows that bio-regulator especially NAA at 50 ppm is very helpful for enhancing the total production of capsicum under controlled condition.

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EFFECT OF LOW DENSITY POLYETHYLENE (LDPE) PACKAGING AND CHEMICALS ON AMBIENT STORAGE OF KINNOW

S.K. Jawandha, P.S. Tiwan and J.S. Randhawa

Department of Horticulture, Punjab Agricultural University, Ludhiana–14004 (Punjab), India

ABSTACT: Study was planned and freshly harvested kinnow fruits were washed and treated with Sodium carbonate (2 & 3 %), Boric acid (2 & 3%) and packed in low density polyethylene (LDPE) bags with perforation and without perforation before packaging in CFB boxes. Fruits were analysed for various physico-chemical characteristics after 15, 30,45 and 60 days of storage. Results revealed that minimum rotting and maximum palatability rating and acidity were registered in Boric acid @ 3 % + LDPE packaging with perforation during the entire storage period. TSS was found maximum in control fruits, whereas minimum physiological loss in weight was recorded in Boric acid @ 3 % +LDPE packaging without perforation. It can be concluded that the storage rots can be reduced by treating the kinnow fruits with Boric acid @ 3 % +LDPE packaging with perforation and fruit health can be maintained up to 45 days at ambient conditions without much deterioration in quality.

Keywords : *Kinnow, storage, boric acid, sodium carbonate, packaging.*

Citrus is one of the most important sub-tropical fruits in the world. Kinnow mandarin a hybrid of King and Willow leaf occupies the prime position amongst the citrus fruits grown in India. It is precocious, prolific bearer and has excellent fruit quality with high juice content. The optimum period of Kinnow maturity is from mid January to mid February. There is often a glut like situation in the market at its peak harvest time. This results in low returns to the growers. There is a need to enhance the shelf-life of Kinnow fruit for its extended marketing during April and May. Earlier, attempts have been made to keep the surplus fruit in cold storage for use during summer months. Most of the cold storages operate at near zero temperature, the kinnow fruit may get pathological rotting during storage. The incidence of microbial fruit rots of fungal and bacterial origin is a common problem in storage, which markedly deteriorate the keeping quality of fruits. The species of *Penicillium, Alternaria, Aspergillus, Botrydi-ploidia* and *Geotrichum* etc. are particularly responsible for causing heavy losses (Kaur, 10). The main factor governing storage life of citrus fruits are weight loss and decay. Individual seal packaging could significantly reduce weight loss and shrivelling, but the potential decay problem of sealed fruits need to be solved through perforation/ chemicals. This paper reports the results of packaging and chemicals on storage rots and quality of Kinnow mandarin at ambient storage.

MATERIALS AND METHODS

The kinnow fruits harvested in January were constituted the study material. The studies were confined to ambient storage. Freshly harvested kinnow fruits were disinfected by washing in chlorinated water (100 ppm) and dried in air. After drying, following pre-storage treatments were given.

T_1= Sodium carbonate (2%) + LDPE packaging with 5 pin holes

T_2 = Sodium carbonate (3%) + LDPE packaging with 5 pin holes

T_3 = Boric acid 2% + LDPE packaging with 5 pin holes

T_4 = Boric acid 3% + LDPE packaging with 5 pin holes

T_5= Sodium carbonate (2%) + LDPE packaging

T_6=Sodium carbonate (3%) + LDPE packaging

T_7=Boric acid 2% + LDPE packaging

T_8=Boric acid 3% + LDPE packaging

T_9=LDPE packaging with 5 pin holes

T_{10}=LDPE packaging without holes

T_{11}=Control (unpacked, untreated)

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Fruits were dipped for five minutes in the treatment solutions, then air dried under shade and individually seal-packed in perforated and unperforated LDPE bags. The bags were sealed with an electric sealer and filled in corrugated fibre board (CFB) boxes and stored in well ventilated room at ambient temperature and relative humidity. For various physico-chemical characters the fruits were analysed after 30, 45 and 60 days at ambient storage. The physiological loss in weight was recorded by noticing the intial weight and final weight in each replication at each storage interval. The cumulative loss in weight was calculated on fresh fruit bases. Spoilage percentage of fruits was also calculated by counting the rotten fruits and total fruits in each treatment replication on each storage interval. The fruits were evaluated by a five member panel on a score card (maximum 10 points) based on physical appearance, taste and flavour. The fruits were rated excellent (8-10), very good (7 -8), good (6-7), fair (5-6) and poor (below 5). The total soluble solids were determined with the help of hand refrectometer. One or two drops of juice were placed on the refrectometer plate and the per cent TSS on the scale were recorded. The reading was calibrated against a standard temperature of 20°C (AOAC, 1).Whereas, acidity was determined by titrating 2 ml of juice against 0.1 N NaOH using phenolphthalein as the indicator. The data obtained were subjected to statistical analysis by following CRD method.

RESULTS AND DISCUSSION

Mean minimum rotting was noticed in boric acid 3.0 %+LDPE packaging with 5 pin holes (Table 1). It might be due to disinfectant, bactericide and cell wall strengthening action of boric acid. The spoilage in seal packed fruits without perforation was more as compared to sealed fruits with perforation. It may be due to accumulation of more humidity in the vicinity of fruits which may aggravates spoilage due to microbial attack. Data also showed that as the storage period increased , the spoilage increased .It might be due to the weakening of the defense system against fungal attack .Similar observations on spoilage over longer period of storage have been reported by Iidis and Travert (8).

Highest palatability rating was recorded in boric acid 3.0 %+LDPE packaging with 5 pin holes during the entire storage period (Table 2). Fruits were in acceptable quality up to 45 day of storage. The palatability rating decreased with increase in storage period. Individually LDPE sealed fruits without perforation developed off-flavor and low palatability rating. It might be due to anaerobic respiration in LDPE sealed fruits without perforation which leads to off flavor.

Mean minimum physiological loss in weight (PLW) was recorded in sodium carbonate 3.0 %+LDPE packaging (Table 3). Reduction in PLW in sealed fruits was due to retardation in evaporation and respiration processes. The chemical application coupled with LDPE sealing was effective in reducing weight loss. It might due to blocking of stomatal apertures and lenticels, thereby reducing the rate of respiration and transpiration. A similar reduction in the physiological loss in weight (PLW) of individually seal packed grape fruit, Shamouti oranges and lemons with HDPE film was probably because of saturated humidity and no air circulation inside the seal package (Ben-Yehousha *et al.*, 2, 3 and 4).

An increase in TSS was recorded with advancement of storage period irrespective of the treatments (Table 4).The increase in total soluble solids with prolongation of storage period may probably be due to increased hydrolysis of polysaccharides and concentration of juice due to dehydration. At the end of storage maximum TSS was recorded in control fruits. It may be due to maximum water loss in these fruits. Similar results were reported by Dhatt *et al.* (5) on kinnow.

At the end of storage maximum acidity was recorded in boric acid 3.0 %+LDPE packaging with 5 pin holes and minimum was recorded in control fruits (Table 5). The decrease in acidity with the storage period might be due to utilization of organic

Table 1: Effect of chemicals and packaging on rotting of Kinnow mandarin during ambient storage.

Treatments	Rotting (%)				
	After 15 Days	After 30 Days	After 45 Days	After 60 Days	Mean
Sodium carbonate(2%) +LDPE with holes	-	5.03	10.00	18.00	8.26
Sodium carbonate(3%) +LDPE with holes	-	7.33	10.00	14.00	7.83
Boric acid (2%)LDPE with holes	1.67	7.53	11.67	15.50	9.09
Boric acid (3%)+LDPE with holes	-	-	5.50	10.5	4.00
Sodium carbonate 2%)+LDPE	20	13.33	18.33	25.00	19.17
Sodium carbonate (3%) +LDPE	5.00	8.33	12.00	18.63	10.99
Boric acid (2%) +LDPE	5.0	12.53	15.00	21.67	13.55
Boric acid (3%) +LDPE	6.67	11.67	13.00	17.25	10.45
LDPE with holes	3.33	8.33	13.00	20.33	11.25
LDPE without holes	1.67	13.33	20.67	32.35	17.01
Control (unpacked untreated)	5.50	15.00	22.46	30.26	18.31
Mean	4.90	9.76	14.51	18.82	12.00

CD (P=0.05): Dates:2.32, Treatments: 2.53, Dates x Treatments: NS

Table 2: Effect of chemicals and packaging on palatability rating of Kinnow mandarin during ambient storage.

Treatments	Palatability rating				
	After 15 Days	After 30 Days	After 45 Days	After 60 Days	Mean
Sodium carbonate(2%)+LDPE with holes	8.7	8.0	7.17	3.5	6.84
Sodium carbonate(3%) +LDPE with holes	8.83	8.0	7.33	4.2	7.09
Boric acid (2%)LDPE with holes	7.67	7.50	7.07	3.5	6.43
Boric acid (3%)+LDPE with holes	8.86	8.5	7.67	4.9	7.48
Sodium carbonate(2%)+LDPE	8.17	7.17	6.83	3.10	6.31
Sodium carbonate(3%) +LDPE	8.0	7.67	7.0	3.17	6.46
Boric acid (2%) +LDPE	7.33	7.17	6.50	3.50	6.12
Boric acid (3%)+LDPE	7.67	7.33	6.67	3.80	6.36
LDPE with holes	8.83	8.17	7.33	3.67	7.00
LDPE without holes	8.00	7.66	7.17	3.85	6.67
Control (unpacked ,untreated)	7.5	5.5	4.5	2.5	5.00
Mean	8.14	7.51	6.84	3.61	

CD (P=0.05) :- Dates:0.85, Treatments: 0.76, Dates x Treatments:1.80

Table 3: Effect of chemicals and packaging on PLW of Kinnow mandarin during ambient storage.

Treatments	PLW (%)				
	After 15 Days	After 30 Days	After 45 Days	After 60 Days	Mean
Sodium carbonate(2%) +LDPE with holes	2.41	4.81	6.05	7.03	5.08
Sodium carbonate(3%) +LDPE with holes	1.70	3.55	5.20	6.89	4.34
Boric acid (2%)LDPE with holes	2.49	4.52	6.33	7.00	5.09
Boric acid (3%)+LDPE with holes	1.77	3.58	5.52	6.80	4.42
Sodium carbonate(2%)+LDPE	1.91	3.41	4.96	6.72	4.25
Sodium carbonate(3%) +LDPE	1.70	3.13	4.54	6.5	3.97
s Boric acid (2%) +LDPE	2.03	3.78	4.72	6.70	4.31
Boric acid (3%)+LDPE	1.72	3.40	4.66	6.66	4.11
LDPE with holes	2.24	3.98	5.78	7.00	4.75
LDPE without holes	1.59	3.42	4.87	6.70	4.15
Control (unpacked ,untreated)	10.5	21.40	32.42	43.63	26.99
Mean	2.73	5.36	7.73	10.15	

CD (P=0.05) :- Dates: 0.32, Treatments: 0.53, Dates x Treatments: 1.20

Table 4: Effect of chemicals and packaging on TSS (%) of Kinnow mandarin during ambient storage.

Treatments	TSS(%)				
	After 15 Days	After 30 Days	After 45 Days	After 60 Days	Mean
Sodium carbonate(2%) +LDPE with holes	11.3	11.5	11.8	12.1	11.7
Sodium carbonate(3%) +LDPE with holes	11.0	11.3	11.5	12.1	11.5
Boric acid (2%)LDPE with holes	11.7	11.9	12.4	12.6	12.2
Boric acid (3%)+LDPE with holes	10.6	11.1	11.7	12.9	11.6
Sodium carbonate(2%)+LDPE	10.8	11.7	12.0	12.0	11.6
Sodium carbonate(3%) +LDPE	10.6	11.0	11.6	11.8	11.3
Boric acid (2%) +LDPE	11.2	11.2	11.6	12.0	11.5
Boric acid (3%)+LDPE	10.5	10.7	11.1	12.0	11.1
LDPE with holes	11.3	11.8	12.3	12.8	12.1
LDPE without holes	11.0	11.7	12.0	12.7	11.9
Control (unpacked ,untreated)	12.0	12.5	13.9	14.3	13.2
Mean	11.1	11.5	12.0	12.5	

CD (P=0.05) :- Dates:0.35, Treatments:0.59, Dates x Treatments: NS

Table 5: Effect of chemicals and packaging on total acidity (%) of Kinnow mandarin during ambient storage.

Treatments	Acidity(%)				
	After 15 Days	After 30 Days	After 45 Days	After 60 Days	Mean
Sodium carbonate(2%) +LDPE with holes	0.64	0.49	0.42	0.34	0.49
Sodium carbonate(3%) +LDPE with holes	0.64	0.52	0.47	0.34	0.49
Boric acid (2%)LDPE with holes	0.68	0.51	0.42	0.34	0.59
Boric acid (3%)+LDPE with holes	0.83	0.70	0.44	0.40	0.48
Sodium carbonate(2%)+LDPE	0.64	0.55	0.40	0.32	0.58
Sodium carbonate(3%) +LDPE	0.70	0.67	0.55	0.40	0.55
Boric acid (2%) +LDPE	0.70	0.67	0.45	0.38	0.63
Boric acid (3%)+LDPE	0.83	0.77	0.52	0.38	0.50
LDPE with holes	0.64	0.60	0.38	0.36	0.55
LDPE without holes	0.77	0.70	0.40	0.34	0.39
Control (unpacked ,untreated)	0.64	0.40	0.30	0.21	
Mean	0.71	0.61	0.43	0.35	

CD (5%):- Dates:0.03, Treatments:0.05, Dates x Treatments: NS

acids in respiration process. A gradual decrease in acidity has also been reported by El-Aswah *et al.* (6), Huelin (7) and Josan *et al.* (9),

CONCLUSION

It may be concluded from the study that Kinnow fruits can safely be stored up to 45 days at ambient storage without much deterioration in quality after treating with boric acid 3.0 %+LDPE packaging with 5 pin holes.

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EFFECT OF PRE-HARVEST APPLICATION OF MICRO-NUTRIENTS ON QUALITY OF GUAVA (*Psidium guajava* L.) CV. SARDAR

A.K. Goswami[1], H.S. Shukla, Prabhat Kumar[2] and D.S. Mishra[2]
C.S. Azad University of Agriculture and Technology, Kanpur- 208 002
[1]Division of Fruits and Horticultural Technology, IARI, New Delhi
[2]Department of Horticulture, G.B.P.U.A.&T., Pantnagar
E-mail: amitk@iari,res.in, amit.tkg@gmail.com,

ABSTRACT: The present investigation was conducted on uniform, healthy, nine year old budded trees of guava (*Psidium guajava* L.) cv. Sardar. Various doses of calcium nitrate, boric acid and zinc sulphate were sprayed twice i.e. 45 and 25 days before harvesting and compared with untreated ones. Each treatment was applied on two trees and replicated thrice in a randomized block design. It was observed that the size of fruit comprises length, diameter, volume were maximum in fruits collected from trees sprayed with zinc sulphate (0.4 per cent). The maximum weight was observed under 0.4 per cent boric acid and it was at par with zinc sulphate at 0.4 per cent. The zinc sulphate 0.4 per cent also improves the physico-chemical parameters at harvest. Among the different treatments pre harvest spray of zinc sulphate at 0.4 per cent wasfound most effective for improving the physico-chemical parameters at harvest and prolonged the shelf-life of fruits exhibiting lower degree of post-harvest losses.

Keywords : *Guava, pre-harvest, micro nutrients, quality, shelf life.*

Guava (*Psidium guajava* L.), a member of the family Myrtaceae, is a well recognized edible fruit of tropical and subtropical climate. It is a native to tropical America stretching from Mexico to Peru and gradually become a crop of commercial significance in several countries because of its hardy nature, prolific bearing, high vitamin C content, pleasant aroma and its good flavour. In recent years guava cultivation is getting popularity due to increasing international trade, nutritional contents and value added products. The crop is being grown on an acreage 2.04 lac ha. with a production 22.70 lakh MT (Anonymous, 2). Uttar Pradesh having largest share in area and production followed by Maharashtra. Since the demand of fruit is increasing in the market, thereby to achieve higher yield of good quality fruit with longer storage life become the priority. To improve the quality of fruit at harvest and to enhance the storage life by influencing the after harvest changes, several research workers have used certain pre-harvest treatments. The application of mineral nutrients like calcium nitrate, boric acid and zinc sulphate are known to play a crucial role in growth, development, quality and storage of fruits (Dixit *et al.,* 6; Jayachandra *et al.,* 8 Singh *et al.,* 11). The present study will contribute in understanding the physical and biochemical status of guava fruits at harvest as influenced by pre-harvest spray of mineral nutrients, which may help in increasing the physico-chemical quality of guava fruits.

MATERIALS AND METHODS

The present investigation was conducted on nine year old budded plants of uniform, healthy and young bearing tree of guava (*Psidium guajava* L.) cv. Sardar, at Horticulture garden of C.S.A. University of Agriculture and Technology, Kanpur, India with ten treatments (T_0 – control, T_1 – 1% calcium nitrate, T_2 – 1.5% calcium nitrate, T_3 – 2% calcium nitrate, T_4 – 0.2% boric acid, T_5 – 0.4 % boric acid, T_6 – 0.6% boric acid, T_7 – 0.2 % zinc sulphate, T_8 – 0.4 % zinc sulphate and T_9 – 0.6% zinc sulphate) which were replicated thrice in a randomized block design. Observations recorded at the time of harvest were weight of fruit, Total soluble solids (TSS), acidity content (A.O.A.C., 1), total sugar content (by 'Fehling solution method' and expressed in percentage), ascorbic acid (mg/100 g of fruit) and for Physiological loss in

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weight (PLW %), the weight of whole fruit was recorded and the cumulative loss at every storage period was worked out in percentage. The data were analysed statistically as per method given by Panse and Sukhatme (10) and results were evaluated at 5% level of significance.

RESULTS AND DISCUSSION

The observations regarding length, diameter and volume of the fruits were significantly affected by application of nutrients. The maximum length (6.18 cm), diameter (5.46 cm) and volume (120.28 cc) recorded in T8 followed by T_5. However fruit weight was maximum in T_5 followed by T_8. The possible reason for increase in these parameters by foliar spray of calcium, boron and zinc might be due to faster mobilization of metabolites into fruits and involvement in cell division and cell expansion as well as increased volume of intercellular space in mesocarpic cells (Brahmachari *et al.*, 4).The maximum accumulation of total soluble solids content (11.8°Brix) in guava fruits was found with the pre-harvest spray of 0.4 per cent zinc sulphate followed by boric acid 0.4 per cent (11.2°Brix) and zinc sulphate 0.2 per cent (11.2°Brix) (Table 1). The T.S.S. of control was found at par with applications of calcium. The present study indicates that acidity content of guava fruits decreased significantly under different treatments. The minimum acidity (0.34 per cent) was observed in zinc sulphate at 0.4 per cent followed by boric acid at 0.4 per cent (0.36 per cent) and maximum acidity content (0.44 per cent) were found in control. The reduction in acid content may be based on the fact that mineral compounds reduced the acidity in fruits, since it is neutralized in plant parts during metabolic pathways and/or used in respiratory process as a substrate.

The total sugar contents in fruits were found to be increased by all the treatments over control. However, it was maximum (9.22 per cent) with the spray of 0.4 per cent zinc sulphate followed by boric acid 0.4 per cent (8.72 per cent). The similar finding were observed by Singh *et al.* (11) who also reported that pre-harvest spray of zinc sulphate and boric acid enhanced the total sugars content of guava fruits.The increase in total sugars can be attributed to the accumulation of oligosaccharides and polysaccharides in higher amount in almost all treatments. It was reported that these micro-nutrients increased the activity of hydrolyzing enzyme, which convert complex polysaccharides into simple sugars (Brahmachari and Rani, 3). All the treatments were significantly effective in increasing the ascorbic acid content of fruits as compared to control. It was found maximum (230.24 mg/100 g) with the pre-harvest application of 0.4 per cent zinc sulphate followed by 0.4 per cent boric acid (210.18 mg/100 g). The Pre-harvest spray of zinc sulphate at 0.5 per cent or 1 per cent enhanced the ascorbic acid content in the fruits of guava (El-Sherifet *et al.*, 7; Mansour and Sied, 9).

In the present study, it has been observed that the per cent physiological loss in weight (PLW %) increased with the progress of storage period under different treatments. There was no spoilage of fruits upto 6 days of storage in all the treatments including control. The spoilage of fruit gradually increased with increasing storage period. The minimum P.L.W. (2.28 per cent) was observed under 0.4 per cent zinc sulphate treatment followed by boric acid at 0.4 per cent (2.42 per cent). All the treatments decreased the per cent cumulative physiological loss in weight as compared to control. The effect of storage period as well as the effect of the interaction (treatments x storages period) was also found significant. The reduced per cent of spoilage in fruits with foliar application of 0.3 per cent zinc sulphate has also been observed in guava by Chaitanya *et al.* (5).

The application of mineral nutrients has favourably influenced the metabolic activities possibly due to their increased endogenous level following external application. These may have enhanced the process of synthesis, translocation and accumulation of quality constituents like TSS, sugars and ascorbic acid following strong source sink relationship. So according to the present findings, the pre harvest spray of zinc sulphate at

Table 1: Effect of mineral nutrients on the length, diameter, weight, volume, TSS, acidity, reducing sugar content, total sugar content and ascorbic acid of guava fruit at harvest.

Treatment	Length of fruit (cm)	Diameter of fruit (cm)	Weight of fruit (g)	Volume of fruit (cc)	TSS of fruit (°Brix)	Acidity of fruit (%)	Reducing sugar content (%)	Total sugar content (%)	Ascorbic acid (mg/100 g)
T_0	4.50	4.56	98.10	96.05	9.6	0.44	3.56	6.68	158.38
T_1	4.58	4.86	106.14	108.12	10.4	0.43	3.78	7.24	178.14
T_2	4.61	4.90	104.12	102.10	10.0	0.41	3.84	7.56	190.32
T_3	4.65	4.78	110.06	108.12	9.8	0.43	3.81	7.30	187.16
T_4	4.78	5.12	112.72	114.14	10.6	0.40	4.16	7.94	196.05
T_5	5.20	5.30	120.87	118.87	11.2	0.36	4.42	8.72	210.18
T_6	4.92	5.00	116.11	114.78	10.8	0.42	4.00	8.04	189.82
T_7	5.28	5.10	114.34	112.37	11.2	0.39	4.30	8.42	208.47
T_8	6.18	5.46	118.78	120.28	11.8	0.34	4.94	9.22	230.24
T_9	5.38	5.24	110.32	112.04	10.8	0.41	3.98	7.76	196.18
C.D. (P=0.05)	0.39	0.39	3.30	4.40	0.91	0.05	0.33	0.96	4.87

Table 2: Effect of mineral nutrients on the physiological losses in weight (%) of guava fruits during storage.

Treatment x Period (TP)	P_0	P_1	P_2	P_3	P_4	P_5	P_6	Mean excluding P_0
T_0	-	2.48	3.90	4.64	5.06	6.36	7.02	4.91
T_1	-	1.92	2.34	3.18	4.28	5.08	5.88	3.78
T_2	-	1.77	2.52	3.83	4.18	5.44	5.93	3.88
T_3	-	1.92	2.68	3.94	5.00	5.67	6.12	4.22
T_4	-	1.58	2.04	2.94	3.69	4.50	5.04	3.30
T_5	-	0.38	1.12	2.98	3.38	4.16	4.94	2.83
T_6	-	1.33	1.76	2.70	3.56	4.44	4.98	3.13
T_7	-	1.18	1.88	2.89	3.62	4.06	4.98	3.10
T_8	-	0.34	1.10	2.45	3.04	4.18	4.85	2.28
T_9	-	1.08	1.62	1.98	3.28	4.20	4.91	2.85
Mean	-	1.39	2.09	3.15	3.90	4.80	5.46	
C.D. (P=0.05)	Tr-0.045		P - 0.03759		T x P-0.119			

T= Treatments P=Periods

0.4 per cent found more effective among the different treatments tried for improving the physico-chemical quality at harvest and prolonged the shelf-life of fruits during storage.

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EFFECT OF ZINC, IRON AND COPPER ON YIELD PARAMETERS OF GLADIOLUS

J.P. Singh, Krishna Kumar and P.N. Katiyar
Department of Horticulture, C.S.A.U.A. & T., Kanpur

ABSTRACT: An experiment entitled "Effect of zinc, iron and copper on yield parameters in gladiolus" was carried out at, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur during the year 2010-11. The experiment consisted two levels each of Zn (Zn_0 and Zn_1), Fe (Fe_0 and Fe_1) and Cu (Cu_0 and Cu_1) which were sprayed on gladiolus plant. The dose of foliar spray of zinc, iron and copper were 0.50%, 0.25% and 0.25%, respectively. Weight of corms significantly increased with the application of Zn and Cu (94.38 and 94.82 g, respectively). Diameter of corms influenced significantly with the application of Zn, Fe and Cu (5.71, 5.77 and 5.81 cm diameter, respectively). Foliar spray of Zn, Fe and Cu, significantly increased the number of corms per plant. Interaction between Zn x Fe and Zn x Cu, significantly enhanced number of corms per plant whereas, the number of corms per plant revealed by Zn (1.74), Fe(1.66) and Cu (1.68) over their respective controls. Maximum increase in cormels production per plant was influenced due to application of zinc (44.97) followed by spray of copper (43.18) and iron (42.11) over their respective controls.

Keywords : *Zinc, iron, copper, corms, cormels, gladiolus.*

Flowers symbolize purity, peace, beauty, love and passion. For Indians especially those who are religious mind, flowers have a great significance. In our society no any social function is completed without the use of flowers. Regarding flowers, gladiolus (*Gladiolus species* L.) is one of the most popular ornamental bulbous plants. It has also known as queen of bulbous flowers. It belongs to family Iridaceae, the most attractive group among the flower crops. It has been appropriately providing a symbol of glamour and perfection. It has second rank after tulip among the bulbous flowers in India and has occupied fourth position in the international trade of cut flowers. The fascinating spike bears a large number of florets with varying sizes and forms with smooth ruffle of deeply crinkled sepals, Presently, in India the area under bulbous crop is about 3500 ha of which gladiolus occupies about more than 1200 ha. The main gladiolus growing places are suited to the north Indian plains. It is grown in the plains as well as hills up to elevation of 2400 m from mean sea levels.

The micronutrients play crucial and vital role in gladiolus production as well as major nutrients in growth and development. The effective study on micronutrients and copper under this aspect zinc, iron is necessary in every stage of plant growth particularly in gladiolus as like in other plants. To determinate the commercial value on corm production parameters, the micronutrients contributes most important role on various metabolism and synthesis process in plants. The deficiency of micronutrients create different abnormalities like chlorosis, rosetting and scorching etc.So, due to influence of different important activities in plant metabolism and synthesis, zinc, ferrus and copper were chosen for search out the effect on production parameter in gladiolus. Proper proportion is yet essential as foliar spray for quality and corm production. Keeping this view in mind a field experiment was conducted at Horticulture Garden, Department of Horticulture, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur to investigate the "Effect of zinc, iron and copper on production parameters in gladiolus during 2010-11 to observe their influences on different attributes of production parameters in gladiolus.

MATERIALS AND METHODS

The experiment on "Effect of Zn,Fe and Cu on production parameters in gladiolus was

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conducted at Horticulture Garden, Department of Horticulture ,Chandra Shekhar Azad University of Agriculture and Technology, Kanpur. The corms of 'Sapna' variety of gladiolus was procured from National Botanical Research Institute Lucknow. The experimental field had loamy soil. Manure and fertilizers were given according to recommendation. The experiment was laid out in Factorial Randomized Block Design with three replications and 8 treatments.The treatments were randomized for getting equal chance in respect of fertility. Row to row and plant to plant spacing was maintained 30 x 20 cm, respectively. Irrigation, weeding, hoeing, earthing up and staking operations were completed according to needs. The spray material was zinc sulphate ($ZnSO_4$), ferrus sulphate ($FeSO_4$) and copper sulphate ($CuSO_4$) containing zinc (21%), Fe (19%) and Cu (24%), respectively. Two sprayings were done with the help of hand sprayer after 20 days and 40 days after planting, respectively. The ground of each bed was covered with polythene sheet. The weight of the harvested corms was recorded with the help of electronic balance and average is denoted in grams (g). After one month of spikes duration when leaves become yellow and dry and dryness comes in whole of the aerial portion, the corms were digout. Corms were practiced to clean and diameter of each corm was measured with the help of vernier callipers and indicated in cm.The number of corms and cormels were recorded at the time of lifting the corm.

Table 1: Effect of Zn, Fe and Cu on weight of corms (g).

Zn x Fe					
Zn / **Fe**	Fe_0	Fe_1	Mean	C.D. (P = 0.05)	
Zn_0	92.82	92.59	92.70	Zn	1.04
Zn_1	93.60	95.16	94.38	Fe	NS
Mean	93.21	93.87	93.54	Zn x Fe	NS
Zn x Cu					
Cu / **Zn**	Zn_0	Zn_1	Mean	C.D. (P = 0.05)	
Cu_0	90.94	93.58	92.26	Cu	1.04
Cu_1	94.47	95.18	94.82		
Mean	92.70	94.38	93.54	Zn x Cu	NS
Fe x Cu					
Fe / **Cu**	Cu_0	Cu_1	Mean	C.D. (P = 0.05)	
Fe_0	92.12	94.30	93.21		
Fe_1	92.41	95.34	93.87		
Mean	92.26	94.82	93.54	Fe x Cu	NS
Zn x Fe x Cu					
Zn **Fe** **Cu**	Zn_0Fe_0	Zn_1Fe_0	Zn_0Fe_1	Zn_1Fe_1	C.D. (P = 0.05)
Cu_0	91.43	92.81	90.46	94.36	Zn x Fe x Cu: NS
Cu_1	94.21	94.40	94.73	95.96	

RESULTS AND DISCUSSION

The mean values of data (Table 1) indicated that weight of corms was significantly increased by foliar spray of Zn and Cu. However, it was not affected significantly with Fe. Application of copper influenced the weight of corms exhibiting 94.82 g corm over its control Cu_0 (92.26 g corm). Similarly, it was registered that weight of corm significantly increased with the spray of zinc showing 92.26 g weight, whereas, its control revealed 92.70 g weight. All the first and second order interactions i.e. Zn x Fe, Zn x Cu, Fe x Cu and Zn x Fe x Cu were caused to numerical increase to this parameter but found non significant. These findings are in agreement with the reports of Halder *et. al.* (3) and Singh and Singh (6) in gladiolus and and Ommarvet *et al.* (4) Singh and Tiwari (7) in onion.

The diameter of corms was measured with the help of vernier calipers and average data were calculated (Table 2). The diameter of corm was significantly affected by Zn, Fe and Cu denoting 5.71 cm, 5.81 cm, and 5.77 cm, respectively and their respective controls (Zn_0, Fe_0 and Cu_0) produced (5.50 cm, 5.44 cm and 5.40 cm, respectively). Interaction between Fe x Cu produced significantly biggest corm in respect of diameter followed by F_0Cu_1 (5.73 cm), Fe1Cu0 (5.65 cm) and Fe_0Cu_0 (5.16 cm). First order interactions *i.e.* Zn x Fe and Zn x Cu were statistically skin. The second order interactions i.e.

Table 2: Effect of Zn, Fe and Cu on diameter of corms (cm).

Zn x Fe					
Zn \ **Fe**	Fe_0	Fe_1	Mean	C.D. (P = 0.05)	
Zn_0	5.34	5.66	5.50	Zn	0.06
Zn_1	5.55	5.88	5.71	Fe	0.07
Mean	5.44	5.77	5.61	Zn x Fe	NS
Zn x Cu					
Cu \ **Zn**	Zn_0	Zn_1	Mean	C.D. (P = 0.05)	
Cu_0	5.29	5.52	5.40	Cu	0.09
Cu_1	5.71	5.91	5.81		
Mean	5.50	5.71	5.61	Zn x Cu	NS
Fe x Cu					
Fe \ **Cu**	Cu_0	Cu_1	Mean	C.D. (P = 0.05)	
Fe_0	5.16	5.73	5.44		
Fe_1	5.65	5.89	5.77		
Mean	5.40	5.81	5.61	Fe x Cu	0.10
Zn x FexCu					
Zn Fe Cu	Zn_0 Fe_0	Zn_1 Fe_0	Zn_0 Fe_1	Zn_1 Fe_1	C.D. (P = 0.05)
Cu_0	5.06	5.26	5.53	5.78	Zn x Fe x Cu NS
Cu_1	5.63	5.84	5.80	5.98	

Table 3: Effect of Zn, Fe and Cu on number of corms per plant.

Zn x Fe					
Zn / Fe	Fe_0	Fe_1	Mean	C.D. (P = 0.05)	
Zn_0	1.44	1.49	1.46	Zn	0.08
Zn_1	1.66	1.83	1.74	Fe	0.05
Mean	1.55	1.66	1.60	Zn x Fe	0.07
Zn x Cu					
Cu / Zn	Zn_0	Zn_1	Mean	C.D. (P = 0.05)	
Cu_0	1.43	1.63	1.53	Cu	0.09
Cu_1	1.50	1.86	1.68		
Mean	1.46	1.74	1.60	Zn x Cu	0.07
Fe x Cu					
Fe / Cu	Cu_0	Cu_1	Mean	C.D. (P = 0.05)	
Fe_0	1.46	1.64	1.55		
Fe_1	1.59	1.73	1.66		
Mean	1.53	1.68	1.60	Fe x Cu	NS
Zn x Fe x Cu					
Zn Fe Cu	Zn_0 Fe_0	Zn_1 Fe_0	Zn_0 Fe_1	Zn_1 Fe_1	C.D. (P = 0.05)
Cu_0	1.40	1.53	1.48	1.73	Zn x Fe x Cu NS
Cu_1	1.48	1.80	1.53	1.93	

Zn x Fe x Cu were also found non significant. These finding are in line with reports of Singh and Singh (6) in gladiolus.

Number of corms was counted at the time of digging. Data (Table 3) indicate that foilar spray of Zn,Fe and Cu significantly increased the number of corms per plant showing 1.74,1.66 and 1.68 corms per plant, respectively when compared with their respective controls Zn (1.46), Fe (1.55) and Cu (1.53). Similarly, all the interactions i.e. Zn x Fe and Zn x Cu significantly enhanced the number of corms per plant, revealing Zn_0 x Fe_0(1.44), Zn_0 x Fe_1(1.49),Zn_1 x Fe_0(1.66) and Zn_1 x Fe_1 (1.63), respectively. Similar trends were identified in interaction of Zn x Cu in respect of number of corms per plant. Maximum value was registered in Zn_1Cu_1 (1.86) followed by Cu_0 Zn_1 (1.63). The minimum number of corms was obtained in Cu_0Zn_0 (1.43). The interactions between Fe x Cu were found to be non significant but it was numerically increased. The maximum number of corms were noted in Fe_1Cu_1 (1.73) followed by Fe_0Cu_1 (1.64). Interaction among Zn x Fe x Cu was found to be non significant but numerically increase the number of corms per plant expressing maximum in $Zn_1Fe_1Cu_1$ (1.93). Similar results has been worked out by Ferandes and Lima filho (2), Halder *et al*. (3) and Sharova *et al*. (5) in gladiolus.

The foliar application of Zn, Fe and Cu significantly increased the number of cormels per plant (Table 4). The number of cormels per plant increased by Zn (44.97), Fe (42.11) and Cu (43.18) over their respective controls Zn_0 (33.69), Fe_0 (36.65) and Cu_0 (35.48). Interaction between Zn x Fe and Zn x Cu caused to enhance the number of cormels per plant. The maximum was occurred with Zn_1Cu_1 (51.33) followed by Zn_1Cu_0(49.78), Zn_1Fe_0 (40.16) and Zn_1Cu_0 (38.62). The interaction

Table 4: Effect of Zn, Fe and Cu on number of cormels per plant

Zn x Fe					
Zn \ **Fe**	Fe_0	Fe_1	Mean	C.D. (P = 0.05)	
Zn_0	32.94	34.44	33.69	Zn	1.98
Zn_1	40.16	49.78	44.97	Fe	1.93
Mean	36.55	42.11	39.33	Zn x Fe	2.73
Zn x Cu					
Zn \ **Cu**	Zn_0	Zn_1	Mean	C.D. (P = 0.05)	
Cu_0	32.34	38.62	35.48	Cu	2.03
Cu_1	35.04	51.33	43.18		
Mean	33.69	44.97	39.33	Zn x Cu	2.73
Fe x Cu					
Fe \ **Cu**	Cu_0	Cu_1	Mean		C.D. (P = 0.05)
Fe_0	32.63	40.47	36.55		
Fe_1	38.33	45.89	42.11		
Mean	35.48	43.18	39.33	Fe x Cu	NS
Zn x FexCu					
Zn Fe Cu	Zn_0 Fe_0	Zn_1 Fe_0	Zn_0 Fe_1	Zn_1 Fe_1	C.D. (P = 0.05)
Cu_0	32.18	33.08	32.51	44.16	Zn x Fe x Cu NS
Cu_1	33.70	47.25	36.38	55.41	

between Fe x Cu were found to be poor and non significant in this regard. Numerically maximum number of cormels was exhibited by F_1Cu_1 (45.89) followed by Fe_0Cu_1 (40.47). These findings are in supports of and Chen *et al.* (1) and Haldar *et al.* (3) in gladiolus.

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EFFECT OF GA_3 AND IAA ON GROWTH AND FLOWERING OF CARNATION

Vijai Kumar, Vipin Kumar, Vandana Umrao[1] and Monbir Singh

Department of Horticulture, Ch. Shivnath Singh Shandilya (P.G.) College, Machhra, Meerut-250 106 (U.P.) India

[1]Department of Ag. Botany

E- mail:umraovk@gmail.com

ABSTRACT: A field experiment was conducted to find out effect of plant growth promotors (GA_3 and IAA) on growth and flowering of carnation under open field condition of Western Uttar Pradesh. Four levels of each of gibberellic acid (0, 50, 100n and 150 ppm) and IAA (0, 100, 200 and 300 ppm) were sprayed on standing crop of carnation in factorial R.B.D. with three replications. Results revealed that higher concentration of GA_3 (150 ppm) or IAA (300 ppm) applied individually responded favourable effects on most of the paramaters studied. The interaction of higher levels of both the hormones (150 ppm GA_3 300 ppm IAA) influenced significantly to all the characters except no. of side shoots and diameter of stem.

Keywords : *Carnation, GA_3, IAA, growth, flowering.*

Carnation (*Dianthus caryophyllus* L.) is one of the most important commercially grown flowers of the world. Excellent keeping quality, wide range of form and colours, ability to withstand long distance transportation and to rehydrate along with its lighter weight have made carnation flower a unique item in cut-flower trade worldwide. Growth and development of carnation is affected by various factors. Plant growth regulators play a vital role for enhancing quality and yield of many commercial flowers (Lal and Mishra, 4; Meher *et al.,* 5). Gibberellic acid plays a major role in plant growth and development. It has been found to be the best for enhancing vegetative attributes along with flower initiation in many commercial flowers. Indole-3- acetic acid (IAA) stimulates cell division, shoots growth, and regulates cell-tissue morphogenesis and inhibits leaf abscission. Enhanced flowering and quality of flowers in carnation can also be obtained by the exogenous application of growth promoting hormones like gibberellic acid and IAA due to their extraordinary responses on cell division, cell elongation and enlargement in the apical regions of the plant. Keeping in the mind the above facts a field trial was made to observe response of GA_3 and IAA sprayings on carnation cv. Lilliput.

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MATERIALS AND METHODS

The study was carried out at experimental field of Department of Horticulture, Ch. Shivnath Singh Shandilya (P.G.) College, Machhra, Meerut (U.P.) India during 2007-2008. Thirty days old healthy seedlings of carnation cv. Lilliput were transplanted in evening hours at a planting distance of 30 × 20 cm in each plot of 90 × 90 cm. Soil of experimental field was sandy loam containing 0.42% carbon, 0.52% nitrogen, 0.008% phosphorus and 0.019% potash. Four levels of each of GA_3 (0, 50,100 and 150 ppm) and IAA (0, 100, 200 and 300 ppm) with a total of 16 treatment combinations were sprayed twice on standing crop at 30 and 45 days after transplanting. Randomly four plants in each plot were selected for observing data on vegetative growth and flowering parameters. Observations on plant height, number of leaf pairs, number of leaves, number of side shoots, diameter of stem, days to first flower initiation, number of flowers, fresh weight of flower, diameter of flower and flower head yield/plot. The experiment was laid out in Factorial R.B.D. and average data obtained was analyzed statistically as per method suggested by Panse and Sukhatme (6).

RESULTS AND DISCUSSION

A perusal of data (Table 1 & 2) revealed that the height of carnation plant was increased significantly at all stages due to foliar application of GA_3 and IAA. Gibberellic acid at 150 ppm level resulted in significantly the tallest plant (44.63 cm) at 60 days after transplanting. Like this, the higher level of IAA (300 ppm) also resulted in maximum plant height (44.20 cm) followed by 200 ppm IAA as compared to their respective controls. Same trend was also observed in their interaction effects, where combined application of 150 ppm GA_3 and 300 ppm IAA resulted significantly the tallest plant (46.53 cm) followed by 100 ppm GA_3 + 200 ppm IAA confirming the results of Kumar *et al.* (3) and Verma (11) in carnation. Gibberellins, when applied exogenous, elongate plant's cell and tissues, thereby increasing height of plant. Higher doses of GA_3 (150 ppm) and IAA (300 ppm) individually as well as their interaction resulted significantly increased number of leaves and leaf pairs/ plant as well. The highest number of leaves/plant (99.50, 88.53 and 83.42 leaves) was recorded with GA_3 × IAA, IAA and GA_3, respectively over their respective controls. Like this, maximum number of leaf pairs/plant was recorded with 150 ppm GA_3 × 300n ppm IAA (50.53 leaf pairs) followed by 100 ppm GA_3 (44.61 leaf pairs) and 300 ppm IAA (43.76 leaf pairs) confirming the findings of Kumar *et al.* (3) in carnation, Singh (8) in Californian poppy and Tyagi *et al.* (10) in calendula.

Number of side shoots in carnation (Table 1 & 2) was also influenced significantly due to exogenous application of GA_3 and IAA, where 150 ppm GA_3 (12.51 shoots/plant), 300 ppm IAA (12.46 shoots/plant) resulted in the maximum number of shoots over their respective controls, while, their interaction effect could not influence this parameter significantly. Results are in conformity with Dua *et al.* (2) in gladiolus and Sharma *et al.* (7) in chrysanthemum. The thickness of stem of carnation due to growth regulators' spray was also influenced significantly and the higher individual dose of GA_3 (150 ppm) and IAA (300 ppm) resulted in significantly the thickest stem of the carnation plant, while their interaction could not influence this parameter significantly confirming the results of Meher *et al.* (5) in zinnia, Sharma *et al.* (7) in chrysanthemum and Tyagi and Singh (9) in African marigold. Days taken to first flower bud initiation (Table 1 & 2) revealed that there were perceptible variations due to applied growth regulators. Flower bud initiation was enhanced linearly with increasing level of gibberellic acid concentration from 50 to 150 ppm. Higher level of GA_3 (150 ppm), IAA (300 ppm) and the interaction (150 ppm GA_3 × 200 ppm IAA) caused earliest flower bud initiation (39.83 day, 40.67 day and 37.0 day, respectively as compared to their respective control values. Like this, number of days taken for first flower opening decreased linearly with increasing levels of both the hormones tested. The highest level of each of GA_3 (150 ppm) and IAA (300 ppm) and their interaction resulted in significantly the earliest flower opening (52.23 day, 51.58 day and 48.33 day, respectively) as their respective controls (60.17, 60.33 and 65.33 day, respectively). Results are in consonance with Bragt (1) in tulip, Kumar *et al.* (3) in carnation, Sharma et al. (7) in chrysanthemum and Singh (8) in Californian poppy.

Results (Table 1 & 2) revealed that number of flowers was also increased linearly with every increase in concentration of GA_3 and IAA tested. The higher level of gibberellic acid (150 ppm) and IAA (300 ppm) individually as well as their interaction resulted in significantly the highest number of flowers/plant (23.75, 24.12 and 29.73 flowers/plant, respectively) as compared to their respective controls confirming the results of Lal and Mishra (4) in marigold, Shrama *et al.* (7) in chrysanthemum and Verma (11) in carnation. The higher level of GA_3 (150 ppm) or IAA (300 ppm) as well as their interaction resulted in the highest fresh weight of individual flower (1.23g, 1.24g and 1.70g, respectively) over their respective control values which are in line with the results of Singh (8) in Californian poppy and Tyagi and Singh (9) in

Table 1: Effect of GA_3 and IAA sprayings on growth and flowering of carnation.

Parameter	Treatment									
	0 ppm GA_3	50 ppm GA_3	100 ppm GA_3	150 ppm GA_3	C.D. (P=0.05)	0 ppm IAA	100 pm IAA	200 ppm IAA	300 ppm IAA	C.D. (P=0.05)
Plant height (cm)	40.52	43.39	43.22	44.63	0.691	41.02	42.86	43.68	44.20	0.691
No. of leaves/pant	67.43	78.22	83.43	90.05	0.569	79.64	77.30	83.65	88.53	0.569
No. of leaf pairs/plant	35.15	39.43	40.65	44.61	0.646	35.18	39.34	41.56	43.76	0.646
No. of side shoots /plant	9.73	10.88	11.71	12.51	0.733	9.68	11.00	11.69	12.46	0.733
Diameter of stem (cm)	0.66	0.76	0.80	0.83	0.055	0.67	0.76	0.79	0.83	0.055
Days to first flower bud initiation	47.92	43.17	41.92	39.83	0.605	46.75	43.75	41.67	40.67	0.605
Days to opening of first flower	60.17	55.33	53.50	52.33	60.33	0.587	56.00	53.42	51.58	0.587
No. of flowers /plant	16.46	20.48	21.83	23.75	0.566	16.97	19.98	21.45	24.12	0.566
Fresh weight of flower (g)	0.92	1.902	1.07	1.23	0.089	0.92	1.02	1.06	1.24	0.089
Diameter of flower (cm)	3.29	3.64	3.75	3.85	0.079	3.39	3.54	3.77	3.82	0.079
Yield of flower heads/plant (g)	15.01	20.28	22.29	29.65	0.556	16.33	19.36	21.92	29.63	0.556

Table 2: Interaction effect of GA_3 × IAA on growth and flowering of carnation.

Treatment Combination	Parameter										
	Plant height (cm)	No. of leaves /pant	No. of leaf pairs /plant	No. of side shoots /plant	Diam. of stem (cm)	Days to first flower bud initiation	Days to opening of Ist flower	No. of flowers /plant	Fresh weight of flower (g)	Diam. of flower (cm)	Yield of flower heads/ plant (g)
G_0I_0	38.00	60.57	31.50	8.50	0.53	50.53	65.33	12.53	0.73	2.90	9.67
G_1I_0	41.50	64.27	35.30	9.97	0.70	47.67	60.33	17.50	0.93	3.47	17.00
G_2I_0	41.50	74.33	36.03	10.23	0.73	46.00	58.33	18.77	1.00	3.60	19.17
G_3I_0	43.07	79.40	37.87	10.00	0.73	43.00	57.33	19.07	1.00	3.60	19.50
G_0I_1	40.43	62.50	34.67	9.93	0.67	49.00	61.67	16.80	0.93	3.20	14.70
G_1I_1	43.37	82.00	39.33	10.37	0.73	42.33	55.00	20.97	1.03	3.67	20.17
G_2I_1	43.07	82.50	41.37	11.40	0.80	42.00	54.00	20.77	1.03	3.60	20.43
G_3I_1	44.57	82.20	42.00	12.30	0.83	41.67	53.33	21.40	1.o7	3.70	22.13
G_0I_2	41.63	67.27	35.53	10.30	0.70	47.33	58.33	17.30	0.97	3.50	17.50
G_1I_2	43.63	81.43	41.00	10.97	0.80	42.00	54.00	20.30	1.03	3.70	20.50
G_2I_2	43.07	86.40	41.67	11.97	0.83	40.33	51.00	23.40	1.07	3.90	21.63
G_3I_2	44.57	99.50	48.03	13.53	0.83	37.00	50.33	24.80	1.17	4.00	28.03
G_0I_3	42.00	79.40	38.90	10.20	0.73	45.00	55.33	19.20	1.03	3.57	18.17
G_1I_3	45.07	85.17	42.07	12.20	0.80	40.67	52.00	23.17	1.07	3.73	23.47
G_2I_3	43.20	90.43	43.53	13.23	0.83	39.33	50.67	24.37	1.17	3.90	27.93
G_3I_3	46.43	99.10	50.53	14.20	0.83	37.67	48.33	29.73	1.70	4.10	48.93
C.D. (P=0.05)	1.383	1.138	1.291	NS	NS	1.210	1.174	1.132	0.178	0.159	1.112

African marigold. Diameter of individual flower was increased linearly with every increase in levels of both the hormones tested. The largest sized flower was found with the spray of higher concentration of GA_3 (150 ppm) or IAA (300 ppm) or their interaction (3.85 cm, 3.82 cm and 4.10 cm, respectively) as compared to their respective control confirming the reports of Meher *et al.* (5) in zinnia, Singh (8) in Californian poppy and Verma (11) in carnation. Yield of flowers per plant was also influenced remarkably with various levels of growth hormones tested in this investigation. Increasing level of GA_3 or IAA resulted a remarkable increase in yield of flower head per plant, and 150 ppm GA_3 or 300 ppm IAA as well as their interaction (150 ppm GA_3 × 300 ppm IAA) resulted in the highest yield of flower heads per plant (29.65g, 29.63g and 48.93g, respectively) as compared to their respective controls which are in line of results of Singh (8) in Californian poppy, Tyagi and Singh (9) in African marigold and Verma (11) in carnation.

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EFFECT OF MICRONUTRIENTS SPRAY ON FRUIT DROP, FRUIT QUALITY AND YIELD OF AONLA CV. BANARASI

Prakash Chandra Singh, Ritesh Singh Gangwar and Vivek Kumar Singh[1]

College of Agriculture, C.S. Azad University of Agriculture and Technology Kanpur-208 002 (U.P)

[1]Department of Horticulture

ABSTRACT : An investigation was carried out during 2006 and 2007 to study the effect of boron (0.1, 0.2 and 0.3%), zinc (0.2, 0.4 and 0.6%) and copper (0.1, 0.2 and 0.3%) alongwith a control on fruit drop, physical parameters and yield of aonla fruits cv. Banarasi. There were ten treatments tried in a RBD. All the characters studied were significantly improved by application of different micro-elements and their levels showing varying degree of their efficacy. The minimum fruit drop (56.84 and 50.22%), maximum length of fruit (4.01 and 4.10cm), breadth (4.31and 4.35 cm), weight (46.85 and 47.34 g) and pulp content (44.66 and 45.16 g) were obtained under the foliar spray of zinc. Among the three concentrations, the higher level proved most effective in respect of all the characters. Zinc at its higher concentration proved the best treatment in improving the yield of aonla.

Keywords : *Zinc, boron, copper, yield, fruit drop, aonla.*

Aonla (*Emblica officinalis* Gaertn.) is one of the important fruit crops of Uttar Pradesh and thrives well even in moderate alkaline soil. The fruits are highly nutritive and rich source of ascorbic acid. The micro-elements play vital role in fruit development and yield and their foliar feeding has gained much importance in recent years because nutrient reach directly to the leaves which are site of metabolism. Among the minor elements zinc, boron and copper play pivotal role in aonla nutrition with regard to increase in size and quality of fruit and yield. Although the effect of these micro elements on yield and fruit drop has been established in major fruit crops but aonla has not received the due attention it deserves. Therefore, the present investigation was planned to investigate the role of micro–nutrients on aonla.

MATERIALS AND METHODS

Forty two years old aonla trees of Banarasi cultivar uniform in growth and vigour growing in Horticulture Garden of C.S. Azad University of Agriculture and Technology, Kanpur were selected for the present investigation. The experiment was laid out in a Randomized Block Design (R.B.D.) for two consecutive years i.e. 2006 and 2007. The soil of the experimental field was of medium fertility having a pH of 7.6. Ten treatments of foliar nutrition comprising three levels each of boron (0.1, 0.2 and 0.3%), zinc (0.2, 0.4 and 0.6%) and copper (0.1, 0.2 and 0.3%) along with a control were applied with the respective concentration of the nutrients.Observations were recorded on fruit drop, fruit size(length and breadth) and pulp weight and yield. The data obtained were analysed statistically as per method of Panse and Sukhatme (5).

RESULTS AND DISCUSSION

The fruit drop in aonla varied greatly with the applied micro- nutrients and their concentrations. The minimum premature drop (54.03 and 48.91%) was observed under zinc spray followed by boron and copper. Among the three concentrations, the higher one (56.84 and 50.22%) showed relatively lesser fruit drop during both the years of study. However, the interactive effect of minerals and their concentrations failed to affect the fruit drop in aonla during both the years. Zinc application in the present experiment might have encouraged the endogenous production of auxin thereby reducing the fruit drop (Awasthi *et al.,* 1). Similar observations have been reported by early worker (Babu and Singh, 2; Kachave and Bhosale, 4).

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Table 1: Effect of B, Zn and Cu on fruit drop physical parameters and yield of aonla

Fruit drop (%)

Treatments	2006 Minerals				2007 Minerals			
	Boron	Zinc	Copper	Mean	Boron	Zinc	Copper	Mean
	2006				2007			
Low	65.05	57.89	74.46	65.80	58.08	53.05	67.39	59.51
Medium	61.42	54.18	68.60	61.40	54.90	49.04	61.79	55.24
High	56.20	50.01	64.31	56.84	49.64	44.64	56.39	50.22
Mean	60.89	54.03	69.12		54.21	48.91	61.86	
Control				76.93				72.24
Treated				61.35				54.99
C.D. (P = 0.05)	M	C	M×C	Tr × Cont.	M	C	M×C	Tr × C
	2.15	2.15	NS	2.77	1.66	1.66	NS	2.15

Fruit length (cm)

Low	3.88	4.05	3.58	3.84	3.91	4.15	3.62	3.89
Medium	3.98	4.12	3.72	3.94	3.99	4.19	3.78	3.99
High	4.00	4.20	3.83	4.01	4.08	4.31	3.90	4.10
Mean	3.95	4.12	3.71		3.99	4.22	3.77	
Control				3.65				3.69
Treated				3.93				3.99
C.D. (P = 0.05)	M	C	M×C	Tr × C	M	C	M×C	Tr × C
	0.13	0.13	NS	0.17	0.12	0.12	NS	0.15

Fruit breadth (cm)

Low	4.10	4.28	3.96	4.11	4.19	4.31	4.02	4.16
Medium	4.16	4.37	4.10	4.21	4.23	4.44	4.19	4.29
High	4.28	4.45	4.21	4.31	4.34	4.48	4.25	4.35
Mean	4.18	4.37	4.09		4.25	4.41	4.15	
Control				3.79				4.01
Treated				4.21				4.27
C.D. (P = 0.05)	M	C	M×C	Tr × C	M	C	M×C	Tr × C
	0.11	0.11	NS	0.51	0.12	0.12	NS	0.52

Fruit weight (g)

Low	39.99	45.07	39.97	41.68	42.17	45.12	39.89	42.39
Medium	41.03	46.85	40.23	42.64	42.68	47.54	41.21	43.81
High	42.38	48.64	41.20	44.07	43.11	49.37	42.57	45.02
Mean	41.13	46.85	40.40		42.65	47.34	41.22	
Control				37.26				38.30
Treated				42.80				43.74
C.D. (P=0.05)	M	C	M×C	Tr × C	M	C	M×C	Tr × C
	1.39	1.39	NS	0.85	1.67	1.67	NS	2.15

Fruit pulp weight (g)

Low	37.85	42.88	37.80	39.51	40.01	42.95	37.72	40.23
Medium	38.88	44.65	37.85	40.46	40.52	45.35	39.03	41.63
High	40.21	46.46	39.03	41.90	40.95	47.19	40.38	42.64
Mean	38.98	44.66	38.23		40.49	45.16	39.04	
Control				35.14				36.15
Treated				40.62				41.67
C.D. (P=0.05)	M	C	M×C	Tr × C.	M	C	M×C	Tr × C
	1.46	1.46	NS	1.89	1.61	1.61	NS	2.09

Fruit yield (kg/tree)

Low	149.64	161.46	142.93	151.34	150.35	162.38	143.50	152.08
Medium	157.72	168.40	148.27	158.13	157.92	166.97	149.97	158.95
High	160.23	174.13	155.58	163.31	161.67	175.36	156.62	164.99
Mean	155.86	167.99	148.93		156.64	168.90	150.03	
Control				130.34				131.17
Treated				157.60				158.53
C.D. (P=0.05)	M	C	M×C	Tr × C	M	C	M×C	Tr × C
	7.69	7.69	NS	9.93	7.93	7.93	NS	10.23

The size of aonla fruit in terms of length and breadth, in the present study was promoted by the foliar feeding of micro nutrients and their concentrations. The effect of zinc in enhancing the fruit size in terms of length (4.12 and 4.22cm) and breadth (4.37 and 4.41cm) was more pronounced as compared to rest of the treatments. On increasing the concentrations of minerals the fruit size was significantly improved and the maximum fruit length (4.01 and 4.10 cm) and breadth (4.31 and 4.35cm) was noticed at higher level during respective yeas. The interactive effect of minerals and their concentrations failed to influence the fruit size of aonla. The increase in fruit size can be attributed to greater translocation of food materials from source to sink under the influence of applied micronutrients (Babu and Singh, 2).

The foliar application of micro-elements caused significant improvement on the fresh weight of aonla fruit and relatively heavier fruits (46.85 and 47.34 g) were harvested under zinc treatment followed by boron and copper. Among the different levels of minerals, the higher concentration produced heavier fruits (44.07 and 45.02g). However, the fruit weight remained unaffected due to interaction of nutrients and their concentrations during both the years of experimentation. The trees receiving foliar nutrition produced fruits weighing 42.80 and 43.74g against 37.42 and 38.30g. recorded under control during 2006 and 2007, respectively. The application of zinc and boron might have caused rapid synthesis of protein and translocation of carbohydrate which ultimately led to increase fruit weight (Babu and Singh 2).

The fresh weight of aonla pulp was significantly influenced by different minerals and their concentrations. The maximum pulp weight (44.66 and 45.16 g) was observed under the foliar application of zinc followed by boron and copper. On increasing the concentrations of different minerals significant improvement on pulp content was noticed and the higher level proved most effective (41.90g) when compared with the rest of concentrations during first year of trial. However, the higher and medium concentrations, in the following year were at par with each other in this

regard. The treated trees produced higher amount of pulp (40.62 and 36.15 g) when compared with control (35.14 and 41.67 g) during both the year of study. Foliar application of zinc and boron might have made rapid synthesis of metabolites particularly carbohydrate and their translocation to the fruits causing relatively greater pulp content (Babu and Singh, 2; Dutta, 3).

The yield of aonla trees was significantly influenced by the preharvest foliar sprays of different micro-elements and their levels. The foliar treatment of zinc (167.99 and 168.99 kg /tree) proved more effective than boron and copper. The increase in concentration of minerals improved the yield of aonla significantly and the yield of 163.31 and 164.99 kg/ tree was observed under higher concentration during both the years of study. The trees under control produced the minimum yield (130.34 and 131.17 kg/tree) and an improvement up to 158.60 and 158.53kg /tree was registered by treated trees. The improvement in yield due to micro-elements may be ascribed to better photosynthesis, less fruit drop, improved fruit size and fruit weight. Similar findings have been recorded in litchi (Babu and Singh, 2) and (Panwar *et al.,* 6) in aonla.

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GENETICAL STUDIES ON ZIMIKAND (*Amorphophallus campanulatus Blume.*)

Sanjive Kumar Singh and S.M. Tripathi
Department of Vegetable Science
C. S. Azad University of Agriculture and Technology Kalyanpur, Kanpur-208 024

ABSTRACT: Phenotypic and genotypic coefficient of variation, heritability, correlation coefficient and path analysis were estimated for plant height, length of leaf, stem diameter, equatorial diameter and corm yield per plant in zimikand (*Amorphophallus campanulatus* Blume). The experiment comprising 18 diverse genotypes have been sown in RBD with 3 replications during 2002-03 and 2003-04 at Vegetable Reaserch Farm of C.S.Azad Uni. of Agr. & Tech.Kalyanpur, Kanpur. The analysis of variance revealed highly significant differences among genotypes for all the characters. High heritability accompanied with moderate genetic advance as per cent of mean for different characters suggested that improvement in corm yield may be made through selection. Phenotypic correlation coefficients of all characters with yield were found positive and highly significant. Yield per plant had strong positive correlation with equatorial diameter and stem diameter at genotypic level. The path coefficient revealed maximum direct effect of equatorial diameter on yield followed by length of leaf in both the years while plant height showed negative direct effect on yield. Thus, the characters like equatorial diameter and leaf length may be considered while making selection for the improvement of yield in zimikand.

Keywords : *Amarphophalus, GCV, PCV, heritability, genetic advance.*

Elephant foot yam or zimikand is an economical and underground tropical tuber crop with a long storage quality. It is cultivated for its corms, used as vegetables. It has both nutritional and medicinal values with high dry matter production capability per unit area than most of the other vegetables. It is originated in India and grown for its under ground tubers which can be stored for long period. It is a popular tuber crop, grown as a vegetable in eastern Uttar Pradesh and many other parts of India. It is a highly remunerative crop which renders its cultivation profitable.

MATERIALS AND METHODS

Studies on variability, heritability, correlation coefficient and path analysis were carried out on 18 diverse genotypes of zimikand for five quantitative characters namely plant height (cm), length of leaf (cm), stem diameter (cm), equatorial diameter (cm) and corm yield per plant (kg). The experiment was conducted for two consecutive years 2002-03 and 2003-04 in RBD with three replications. Ten plants in each replication represented each genotype. During crop growth and at harvest, observations were recorded on five randomly selected plants. The data were analyzed as per procedure given by Panse and Sukhatme (3). Genetic coefficients of variation were estimated by the formula suggested by Burton (1). Heritability in broad sense was calculated in accordance with Hanson *et al.* (2).

RESULTS AND DISCUSSION

The analysis of variance revealed highly significant differences among genotypes for all the five characters viz; plant height, length of leaf, stem diameter, equatorial diameter and corm yield/plant (Table 1). The length of leaf showed maximum genetic coefficient of variation during both the years, while yield per plant exhibited minimum genotypic coefficient of variability. During 2002-03, the maximum *pcv* was observed for length of leaf while stem diameter showed the maximum *pcv* during 2003-04. Similar to *gcv*, yield per plant exhibited minimum *pcv* in both the years. The heritability ranged from 72 to 85 per cent for equatorial diameter being minimum and length of leaf and yield/plant being maximum during

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Table 1: Analysis of variance for 5 characters in zimikand.

Source of variance	df	MSS									
		Plant height		Length of leaf		Stem diameter		Equatorial diameter		Corm Yield/plant	
		2002-03	2003-04	2002-03	2003-04	2002-03	2003-04	2002-03	2003-04	2002-03	2003-04
Rep.	2	36.61*	1.34	35.6**	3.54	0.04	0.09*	7.94	3.96	2.81	0.07
Treat.	17	133.02**	151.47**	86.10**	55.14**	0.31**	0.34**	53.68**	46.86**	24.81**	15.09*
Error	34	7.70	5.87	4.49	2.41	0.02	0.02	6.15	3.19	1.34	3.26

*Significant at 5% level; **Significant at 1% level

Table 2: G.C.V., P.C.V., heritability and genetic advance in per cent over mean for different characters in zimikand.

Characters	GCV		PCV		Heritability in % (bs)		Genetic advance in % over mean	
	2002-03	2003-04	2002-03	2003-04	2002-03	2003-04	2002-03	2003-04
Plant height	16.37	18.89	17.81	20.00	84	89	30.97	36.77
Length of leaf	19.63	19.69	21.18	21.00	85	87	37.44	38.06
Stem diameter	17.37	19.59	19.10	21.10	82	86	32.40	39.37
Equatorial diameter	14.28	15.40	16.83	17.00	72	82	24.98	28.74
Corm yield/plant	8.84	6.46	9.57	8.72	85	54	16.82	3.85

Table 3: Phenotypic (Upper diagonal) and genotypic (Lower diagonal) correlation coefficient for different characters in zimikand.

Characters	Plant height		Length of leaf		Stem diameter		Equatorial diameter		Yield	
	2002-03	2003-04	2002-03	2003-04	2002-03	2003-04	2002-03	2003-04	2002-03	2003-04
Plant height			0.578**	0.811**	0.681**	0.722**	0.761**	0.338	0.454**	0.481**
Length of leaf	0.513	0.724			0.760**	0.879**	0.552**	0.375	0.568**	0.622**
Stem diameter	0.615	0.666	0.640	0.775			0.691**	0.531**	0.554**	0.631**
Equatorial diameter	0.629	0.305	0.430	0.328	0.565	0.492			0.639**	0.847**
Yield	0.379	0.316	0.456	0.492	0.510	0.465	0.500	0.591		

T**able 4: Direct and indirect effects of different characters on yield in zimikand.**

Characters	Year	Plant height	Length of leaf	Stem diameter	Equatorial diameter	Genotypic correlation for yield
Plant height	2002-03	**-0.217**	0.197	0.022	0.452	0.454
	2003-04	**-0.138**	0.588	-0.238	0.269	0.481
Length of leaf	2002-03	-0.126	**0.341**	0.024	0.328	0.568
	2003-04	-0.112	**0.725**	-0.290	0.299	0.622
Stem diameter	2002-03	-0.148	0.259	**0.032**	0.411	0.554
	2003-04	-0.100	0.638	**-0.330**	0.423	0.631
Equatorial diameter	2002-03	-0.165	0.188	0.022	**0.594**	0.639
	2003-04	-0.047	0.272	-0.175	**0.797**	0.847

Bold values showed direct effect

Residual effect – 0.507

0.650

2002-03. During 2003-04, the maximum heritability was recorded for plant height while minimum for yield per plant. The genetic advance in % age over mean reflects that length of leaf and stem diameter showed maximum during 2002-03 and 2003-04, respectively while yield per plant exhibited minimum in each year. Thus the genetic material under study had great genetic variability. High heritability accompanied with moderate genetic advance as per cent of mean revealed that improvement in the corm yield may be made through selection (Table 2).

Generally phenotypic correlation coefficients were higher than their genotypic correlation coefficients (Table 3), which reflected that environments have role for the expression of these characters. At genotypic level, yield had very strong correlation with equatorial diameter, stem diameter and length of leaf during each year. Among yield components, length of leaf had very strong correlation with stem diameter and plant height. Yield had positive and significant correlation with length of leaf, stem diameter and equatorial diameter, while remaining combinations showed positive correlation coefficient at phenotypic level.

A perusal of data (Table 4) revealed maximum positive direct effect of equatorial diameter on yield followed by length of leaf. The yield had positive and strong genotypic correlation with these characters. Plant height had negative direct effect on yield. However, it had positive genotypic correlation which may be due to positive indirect effect of equatorial diameter and leaf length. The high residual values (0.507 and 0.650) revealed that many characters have been left for study.

On the basis of above studies it may be concluded that equatorial diameter and length of leaf are the major yield components. Hence selection should be based on these two characters, while making selection for the improvement in zimikand.

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EFFECT OF GA_3 AND BA ON FRUIT WEIGHT, QUALITY AND RIPENING OF 'ROSE SCENTED' LITCHI

D.S. Mishra, Prabhat Kumar and Rajesh Kumar

Department of Horticulture, College of Agriculture, G.B. Pant University of Agriculture & Technology, Pantnagar–263145, U.S. Nagar, Uttarakhand

ABSTRACT: An attempt was made to study the effect of GA_3 and BA on ripening of litchi cultivar Rose Scented. In this attempt, KNO_3 (4%) was sprayed at 1 cm size of panicle in the first week of February. However, other treatments viz. GA_3 (20, 40 ppm) and BA (20, 40 ppm) were applied two weeks before expected date of harvest (on 15th May). KNO_3 (4%) advanced the harvesting date only for 2 days in comparison to control. GA_3 20 and 40 ppm delayed the harvest date for 2 and 5 days, respectively while BA 20 ppm and 40 ppm delayed the harvest date for 5-6 days. In all the treated trees, fruit weight was found to be more than 21g as compared to control. Higher fruit quality attributes were recorded with GA_3 (40 ppm) followed by GA_3 20 ppm over other treatments. Reduced fruit cracking was also observed in trees which were sprayed with GA_3 and BA.

Keywords : *GA_3, BA, litchi, quality, ripening.*

Uttarakhand is one of the most popular states of the country known for its quality litchi production. The litchi industry in Uttarakhand is based on one major cultivar, the 'Rose Scented'. Its harvesting period is quite short, 7 to 10 days. The availability of fresh litchi fruits in the market may be extended for another few days by utilizing other genotypes available in the litchi. However, much scope is not there as available genotypes differ little with regard to their maturity period (Ray and Sharma, 9). Two pronged strategy may be employed to solve the problem *i.e.,* either advancing the date of harvest or delaying the date of harvest.

Still, there is no commercial method to be used for either advancing or delaying the harvesting time of litchi and thus extending the harvesting and marketing season. The motive of this study was to test methods for extending harvesting period of litchi. An alternative approach to induce early flowering and fruiting by using KNO3 has been successfully used in mango (Kumar *et. al.,* 7). GA_3 has been found to offer suitable means of controlling ripening process in litchi (Ray and Sharma, 9) and in other fruit crops (Dilley, 4 and Lavon et. al., 8). Evidence suggests that cytokinins retards sugar accumulation and pigmentation in litchi fruits (Wang *et. al.,* 11). However, little information is available on use of KNO_3, GA_3 and BA in 'Rose Scented' litchi with regard to their effect on fruit yield, quality and ripening. The objective of this study was to determine the effect of KNO_3, GA_3 and BA on 'Rose Scented' litchi fruit maturity, size and quality.

MATERIALS AND METHODS

The experiment was carried out in 2007 and 2008 at HRC, Patharchatta, G.B.P.U.A&T., Pantnagar on 20 year old plants of litchi cv. Rose Scented, spaced at10 x 10 m and maintained under uniform cultural practices. The experiment was laid out in a randomized block design with three replications. All the treatments were applied after fruit set except 4% KNO_3 (T_1), which was sprayed at 1 cm panicle stage in the month of February. GA_3 at 20 ppm (T_2), 40 ppm (T_3) and BA (6-Benzyl adenine) at 20 ppm (T_4), 40 ppm (T_5) were sprayed only once, on 15th May *i.e.* 2 week before from expected date of normal harvest. Teepol (2 ml/l) was added to the solution as wetting agent. There were total 6 treatments including control (T_6). All treatments were applied to separate trees.

Randomly 10 panicles in each direction of the tree were selected in each treatment for recording

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Table 1: Effect of treatments on harvest advancement/delay and fruit quality of litchi cv. Rose Scented.

Treatment	Days taken to maturity	Harvest*(day)		Fruit cracking (%)	Fruit weight (g)	TSS (°Brix)	Acidity (%)	Ascorbic acid (mg/100 g)	Total sugar (%)
		Advancement	Delay						
T_1 (4% KNO_3)	58.33	2.82	-	10.77	22.20	20.52	0.52	27.99	13.43
T_2 (GA_3 20 ppm)	63.00	-	1.85	7.43	22.25	21.00	0.63	28.56	13.58
T_3 (GA_3 40 ppm)	66.85	-	5.70	6.13	22.30	22.15	0.60	28.83	14.25
T_4 (BA 20 ppm)	66.00	-	4.85	7.99	22.31	21.75	0.61	28.53	13.02
T_5 (BA 40 ppm)	67.00	-	5.85	7.93	22.24	21.40	0.66	28.92	13.20
T_6 (Control)	61.15	-	-	12.71	19.06	18.63	0.55	25.84	12.52
CD (P=0.05)	1.84			3.85	1.03	1.26	0.045	NS	0.34

* Harvest advancement/delay was counted by considering the date of harvest of control plants

data on fruit cracking, fruit weight, TSS, acidity ascorbic acid, total sugar and days taken to maturity. The fruits were considered to be ripe when they developed a bright pinkish-red blush with flattened tubercles (Gaur and Bajpai, 6). TSS was determined by using ERMA hand refractometer and acidity, recorded as malic acid, by titration of the juice with 0.1 N NaOH using phenolphthalein as the indicator. For estimating ascorbic acid, the fresh juice to which 4% metaphosphoric acid as stabilizing reagent had been added was titrated against 2:6 dichloro-indo-phenol dye solution.

Reducing sugars were determined by titrating the juice with feliling's solutions A and B (standardized) using methylene blue as indicator. For determining total sugars, the juice was subjected to acid hydrolysis and total sugars were estimated by the method described for reducing sugars. The results were analyzed statistically for each year and ultimately the pooled estimates for both the years were worked out.

RESULTS AND DISCUSSION

In general, all the treatments except T_1 (4% KNO_3) and delayed ripening and thus extended the harvesting period in litchi cv. Rose Scented. However, treatments T_1 advanced the harvest period by 2 days as compared to control (Wang *et. al.,* 11). Significantly fruit cracking was reduced by all concentrations of GA_3 and BA in comparison to other treatments.

Spray of GA_3 at 40 ppm delayed harvesting by 6 days as compared to control with reduced fruit cracking, as well as acidity and with improved fruit weight, TSS, ascorbic acid and total sugars. Increase in fruit weight with enhanced fruit quality attributes and harvest delay in litchi with exogenous application of GA_3 has been reported earlier by Ray and Sharma (9) in litchi. Enhanced fruit weight and other physico-chemical attributes were observed by spray of GA_3 @ 5 to 10 mg/l in 'Yu Her Pau' litchi (Chang and Lin, 2). Gibberellic acid (GA_3) applied as a foliar spray during colour break prolonged on tree storage of citrus has also been reported (El-Otmani *et. al.,* 5).

The harvest delay resulting from BA at 40 ppm was 5.5 days which is comparable to that gained with the use of gibberellic acid 40 ppm. Fruit quality attributes of BA treated fruits was at par with GA_3 treated fruits. There is little information concerning the influence of cytokinins on fruit weight, quality and prolonged date of harvest in litchi. Dhua *et. al.* (3) found that application of kinetin (25 mg/l) to litchi trees after

25 days of fruit set increased the fruit weight and delayed development of fruit colour due to presence of higher chlorophyll content in the peel. Delayed maturity with 6-Benzyl adenine (BA) as observed during present investigation corroborated the finding of Bayer (1) and Wang *et. al.* (11). Cytokinin either inhibit or delay the colour changes in litchi fruit green to red associated with ripening though without influencing other changes markedly also supports the earlier finding of Wang *et. al*. (11).

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Research Note :

CORRELATION STUDY FOR PHYSICO-CHEMICAL CHARACTERS IN *JAMUN*

Vartika Srivastava[1], Prabhat Kumar[2] and P.N. Rai[2]

[1]*Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi-221 005(U. P.)*

[2]*Department of Horticulture, G. B. Pant University of Agriculture and Technology, Pantnagar (Uttarakhand)*

Keywords : *Jamun, physico-chemical traits, correlation.*

The correlation study between the physical and chemical characters are very useful in understanding the selection procedure for high yielding clones in *jamun*. Most of the jamun trees available in India are seedling type in origin. Due to allogamous nature and pre-dominance of seed propagation, enormous variability exists in respect to morphology and physico-chemical characters of fruits. However, no elite line has been recognized and very meager information is available on improvement of jamun fruit crop. To initiate any crop improvement programme, selection and hybridization are the important methods. The success of an improvement programme depends mostly on the identification and selection of superior parents for hybridization. Therefore, exploitation of existing variability for improvement of *jamun* in order to encourage commercial orcharding in India was carried out in Pantnagar and Varanasi regions of Uttarakhand and Uttar Pradesh, respectively.

The present study was conducted in laboratory of Department of Horticulture, G.B. Pant University of Agriculture and Technology in July, 2006. The experimental material for this study comprised of twenty five selected jamun trees. Twenty trees were selected from Varanasi region (B.H.U campus) and five trees from Pantnagar campus. The data was analyzed according to the procedure of analysis of variance for complete randomized design (CRD) with three replications in each treatment. The fruits from each tree were collected and observations for physical parameters viz., fruit weight, average fruit size, seed size, seed weight, pulp:seed ratio, pulp percentage etc. and chemical properties viz., total soluble solids, acidity, TSS:acid ratio, total sugars, reducing & non-reducing sugars, Sugar:acid ratio & ascorbic acid were recorded. The estimates of correlation coefficient between all possible pairs of physico-chemical characters of fruits were worked out as suggested by Panse and Sukhatme (3).

In the present correlation study of physico-chemical characters of *jamun* fruits (Table 1) a highly significant positive correlation of fruit length with fruit breadth, seed length, fruit weight and seed weight was recorded whereas significant positive correlation with fruit volume was observed. Fruit breadth was also recorded to be highly significant and positively correlated with seed length, seed breadth, fruit weight, seed weight and fruit volume. A highly significant but negative correlation between fruit breadth and fruit length:breadth ratio was observed. Significant negative correlation was observed between fruit length:breadth ratio and seed breadth. Seed length was highly significant and positively correlated with fruit weight and seed weight. A significant positive correlation between seed length, seed breadth and fruit volume was observed. Seed breadth was highly significant and positively correlated with fruit weight and fruit volume. A significant positive correlation was observed between seed breadth and seed weight, whereas a

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Table 1: Correlation analysis of different fruit characters of Jamun.

	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	0.567**	-0.106	0.581**	0.103	0.21	0.511**	0.289	0.156	0.523**	-0.309	0.142	0.023	0.148	0.284	0.284	0.019	0.403*	0.198	-0.011	-0.144
2		-0.831**	0.612**	0.523**	-0.242	0.554**	0.326	0.167	0.651**	-0.221	0.108	-0.006	-0.035	0.339	0.339	-0.048	0.572**	0.19	-0.039	-0.214
3			-0.303	-0.501*	0.396	-0.246	-0.14	-0.045	-0.394	0.003	0.026	-0.028	0.100	-0.133	-0.133	0.094	-0.38	-0.035	-0.004	0.058
4				0.478*	0.036	0.525**	0.279	0.003	0.661**	-0.151	0.11	0.013	0.183	0.184	0.184	0.117	0.443*	0.076	-0.031	-0.133
5					-0.847**	0.539**	0.329	0.093	0.472*	-0.229	0.244	-0.520**	0.04	-0.086	-0.086	-0.023	0.644**	0.106	-0.21	-0.355
6						-0.297	-0.167	-0.055	-0.24	0.12	-0.147	0.567**	0.111	0.219	0.219	0.103	-0.444*	-0.034	0.191	0.298
7							0.805**	0.542**	0.396*	-0.828*	0.749**	-0.393	0.425*	0.233	0.233	0.003	0.922**	0.521**	-0.403*	-0.564**
8								0.721**	0.007	-0.828**	0.852**	-0.349	0.594**	0.226	0.226	0.072	0.797**	0.607**	-0.512**	-0.589**
9									-0.257	-0.711**	0.829**	-0.274	0.445	0.255	0.255	0.132	0.628**	-0.381	-0.221	-0.379
10										0.127	-0.28	-0.051	-0.233	0.13	0.131	-0.099	0.294	0.075	-0.047	-0.184
11											-0.925**	0.324	-0.548**	-0.168	-0.168	-0.073	-0.769**	-0.512**	0.419*	0.472*
12												-0.388	0.639**	0.124	0.124	0.094	0.761**	0.477*	-0.404*	-0.474*
13													-0.149	0.101	0.102	0.148	-0.499*	-0.326	0.372	0.621**
14														0.012	0.012	-0.052	0.396*	0.254	-0.228	-0.19
15															1.00**	-0.236	0.236	0.398*	0.18	-0.337
16																-0.236	0.236	0.398*	0.18	-0.337
17																	-0.127	-0.112	-0.102	0.105
18																		0.446*	-0.313	-0.551**
19																			-0.795**	-0.887**
20																				0.771**

1-Fruit length, 2- Fruit breadth, 3-Fruit Length:Breadth ratio, 4-Seed length, 5-Seed breadth, 6-Seed L:B, 7-Fruit weight, 8-Pulp Weight, 9-Pulp percentage, 10-Seed Weight, 11-Seed percentage, 12-Pulp:Seed ratio, 13-TSS, 14-Ascorbic acid, 15-Total sugar, 16-Reducing sugar, 17-Non reducing sugar, 18-Fruit volume, 19-Titrable acidity, 20-Sugar:Acid, 21-TSS:Acid ratio.

highly significant but negative correlation with seed length:breadth ratio was observed. Seed length:breadth ratio was significant but negatively correlated with fruit volume.

A highly significant positive correlation of fruit weight with fruit length, seed length, pulp weight, pulp percentage, fruit volume and pulp to seed ratio was recorded. A significant positive correlation was observed with seed weight and a highly significant negative correlation was found with seed percentage. Pulp weight was highly significant and positively correlated with pulp percentage, fruit volume and pulp:seed ratio, whereas highly significant but negative correlation with seed percentage was observed. Pulp percentage was highly significant and positively correlated with pulp:seed ratio and fruit volume, whereas a highly significant negative correlation was observed between pulp percentage and seed percentage. Seed percentage showed highly significant but negative correlation with fruit volume and pulp:seed ratio. A highly significant positive correlation was found between pulp:seed ratio and fruit volume.

Highly significant positive correlation of TSS with length:breadth ratio of seed and TSS:Acid ratio was observed, whereas highly significant but negative correlation was observed with seed breadth. A highly significant and positive correlation of TSS:acid ratio with sugar:acid ratio was recorded whereas a highly significant but negative correlation with fruit weight, pulp weight, fruit volume and titrable acidity was recorded. A significant but negative correlation with pulp:seed ratio was also recorded.

Acidity was highly significant and positively correlated with fruit weight and pulp weight. A significant and positive correlation with pulp:seed ratio, total sugar, reducing sugar and fruit volume was observed, whereas a highly significant but negative correlation with seed percentage was recorded. Highly significant and positive correlation of ascorbic acid with pulp weight and pulp:seed ratio was observed whereas a significant positive correlation with fruit weight and pulp percentage was recorded. A highly significant but negative correlation with seed percentage was also reported. Reducing sugar showed highly significant positive correlation with total sugar and a significant positive correlation with titrable acidity. Sugar:acid ratio was significant and positively correlated to seed percentage whereas it was highly significant but negatively correlated with pulp weight and titrable acidity.

Correlation study between different physico-chemical characters of fruits from the selected *jamun* genotypes showed highly significant positive correlation of pulp weight, fruit volume, pulp to seed ratio and titrable acidity with fruit weight. Seed percentage had highly significant but negative correlation with fruit weight. These findings are in accordance with Asna *et al.* (1) in Cape gooseberry and Inamdar *et al.* (2) in *jamun*. To conclude, major emphasis in selection should be given for higher pulp weight, fruit volume, fruit size & pulp: seed ratio. Also higher TSS and acidity along with less seed sized should be considered for selecting superior genotypes.

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Research Note :

GENETIC VARIABILITY FOR SOME METRIC TRAITS IN STRAWBERRY (*Fragaria* × *ananassa* Duch.)

Bijay Kumar, Sanjay Kumar and Yogesh Chandra Yadav
Department of Applied Plant Science (Horticulture)
Babasaheb Bhimrao Ambedkar University,(A Central University)Vidya-Vihar, Rae Bareli Road, Lucknow-226 025
E-mail-sanjay123bhu@gmail.com

Keywords: *Genetic variability, strawberry.*

The cultivated strawberry (*Fragaria* × *ananassa* Duch.), octaploid in nature, is derived from two North American species, Fragaria chiloensis and Fragaria verginiana, which were first developed in France in the 17th century. The strawberry belongs to the family Rosaceae. Strawberry is an important fruit crop whose cultivation has ample scope near the cities having fruit preservation factories. Considerable variation exists in various cultivars which can be exploited for the benefit of fruit growers in subtropical/ temperate area. The wide variation in climates within these regions and the wide adaptation of the strawberry plant permit harvesting and marketing the fruit during greater part of the year. Strawberry is a delicious fruit taken fresh in several ways. It also makes excellent ice-cream and jam on account of its rich aroma, and is also a good source of vitamin C. It is a soft and a highly perishable fruit, often shipped in frozen condition in Western countries. Fruit may be conical, round and long to conical, conical with constricted base and cylindrical ground depending upon the variety, and immature fruit is consumed in a number of ways. The fruit contains 89.9 per cent moisture, 0.7g protein, 8.4g carbohydrate, 0.5g fat and 59 mg vitamins C per 100g fruit of fresh weight. It is good for people suffering from biliousness and indigestion. The genetic improvement in any crop depends upon the available genetic variability for important quantitative traits and its judicious exploitation through efficient breeding method. Selection of plants plays important role among various breeding approaches at one or more stages as it acts on available genetic variability to evolve superior genotypes. The nature and amount of genetic variability available in the germplasm indicate the scope of improvement in the character through selection. However, the efficiency of selection in improving the character by exploiting the genetic variability depends mainly upon the extent of transmissibility of the character in question the genotype and phenotypic coefficient of variation and helpful in expressing the nature of variability in the breeding population, whereas, the estimate of heritability provides index of transmissibility of characters.

The present experiment entitled was carried out at Horticulture Research Farm, Department of Applied Plant Science (Horticulture), Babasaheb Bhimrao Ambedkar University, Lucknow (UP) during the year 2009-2010. The runners of 16 genotypes of strawberry were brought from the Regional Station of Indian Agricultural Research Institute, Amartara Cottage and Shimla (H.P.) in the month of October 2009. The runners were kept for two days in shade for hardening before transplanting in well prepared beds under open field condition plots which were distributed randomly in three replications. The plant to plant and row to row spacing were maintained at 30 x 30 cm, respectively. The sixteen genotypes Pusa Sweet (S-5), Larsan, Red Coat, Himalayan Scarlet (S-1), Katrain Sweet, Sea Scape, Etna, Sweet Charlie, Dana, Torrey, Fern, Addie, Selva, Phenomenal, Chandler, Pajaro were used as experimental

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materials. The observations were recorded on height of plant (cm), spread of the plant, number of leaves per plant, number of flowers per plant, number of fruits per plant, fruit yield per plant, length of fruit, fruit diameter, average fruit weight, total soluble solids (T.S.S.) and titrable acidity (%).The analysis of variance, variability for different quantitative characters, were heritability and expected genetic advance were calculated by following standard statistical procedures.

Analysis of variance for twelve characters of parents of strawberry (Table 1) shows that mean sum of square due treatment was highly significant for all the characters under study. The phenotypic coefficient of variation (PCV) was higher than their respective genotypic coefficient of variation (GCV) for all the traits under study (Table 2).

The heritability value for trait was found to be 83.0%. The value of expected genetic advance was noted to be 11.60%.The number of flowers per plant varied between 11.67 to 23.69 with a general mean of 17.62. The phenotypic and genotypic coefficient of variation was observed to be 17.65 to 16.48, respectively. The heritability value for this trait was 87.20%. The expected genetic advance was found to be 7.90 %. The data of experiment showed that the number of fruits per plant recorded between 8.33 to 19.98 with a general mean of 14.15. The phenotypic and genotypic coefficient of variation was observed to be 21.96 to 21.10, respectively.

The heritability value for this trait was 92.3%. The expected genetic advance was found to be 8.25%).The fruit length varied between 3.06 to 4.26 cm to with a general mean of 3.96. The genotypic coefficient of variability was 11.17 and phenotypic coefficient of variation was 7.62. The heritability value was recorded to be 47.0% (Table 2). The expected genetic advance was recorded to be 0.50%.The fruit diameter was recorded between18.77 to 33.93 (mm) with a general mean of 26.35 mm. The phenotypic coefficient of variation was 20.32 and genotypic coefficient of variation was 18.65 for this character. The heritability value was recorded to be 84.3%. The expected genetic advance was recorded to be 11.63%. The highest fruit yield per plant was observed 112.70 g, while, lowest to be 32.49 g with a general mean was recorded to be 72.59 g. The phenotypic and genotypic coefficients of variation were recorded to be 32.61 and 31.89, respectively. Findings are in consonance with Asrey and Singh (1), Lal and Seth (3) and Verma *et al.* (5).

The value of heritability for fruit yield was noted 96.0% and expected genetic advance was 53.56%. Average fruit weight of edible ripe fruit for 16 genotypes ranged from 3.97 to 10.15 g with a general mean of 7.06. The phenotypic and genotypic coefficient of variation was recorded to

Table 1: Analysis of variance for sixteen genotypes of Strawberry.

S. No.	Source of variation	D. F.	Characters											
			Height of plant (cm)	Spread of plant (cm)	No. of leaves per plant	No. of flowers per plant	No. of fruits per plant	Fruit length (cm)	Fruit diameter (mm)	Fruit yield per plant (g)	Average fruit weight (g)	T.S.S °B	Titrable acidity (%)	Ascorbic acid (mg/ 100 g fruit)
1.	Replication	2	0.59	13.00	7.30	13.20	12.33	0.21	0.37	107.64	0.11	1.05	0.001	2.54
2.	Treatments	15	0.82**	24.93**	97.94**	32.31**	32.65**	0.33**	73.3**	1410.65**	9.87**	12.17	0.02**	157.58**
3.	Error	30	0.31	7.20	13.14	1.50	0.88	0.09	4.29	21.21	0.12	0.04	00002	0.40

** Significant at 1%; *Significant at 5% level of significance.

Table 2: Estimation of the range, coefficient of variation, genotypic and phenotypic coefficient of variation, heritability and genetic advance for 12 characters in strawberry.

Sl. No.	Characters	Range		Phenotypic variation	Genotypic variation	PCV (%)	GCV (%)	Heritability (%)	Genetic advance
		Minimum	Maximum						
1.	Height of plant(cm)	8.67	10.16	0.48	0.17	7.54	4.48	35.3	7.01
2.	Spread of plant(cm)	21.47	32.35	13.11	5.91	13.87	9.32	45.1	16.51
3.	No. of leaves per plant	25.78	43.70	41.40	28.27	19.82	16.37	68.3	35.71
4.	No. of flowers per plant	11.68	23.69	11.77	10.27	17.65	16.48	87.2	40.64
5.	No. of fruits per plant	8.34	19.98	11.47	10.59	21.96	21.1	92.3	53.53
6.	Fruit length (cm)	3.06	4.26	0.17	0.08	11.17	7.62	46.6	13.73
7.	Fruit diameter (mm)	18.78	33.93	27.29	23.00	20.32	18.65	84.3	45.21
8.	Fruit yield per plant (g)	32.49	112.70	484.35	463.15	32.61	31.89	95.6	82.32
9.	Average fruit weight (g)	3.97	10.15	3.36	3.25	28.10	27.61	96.5	71.60
10.	T.S.S °B	5.06	12.03	4.08	4.04	25.90	25.78	99.1	67.75
11.	Titrable acidity (%)	0.57	0.75	0.005	0.01	12.25	11.98	95.7	30.92
12.	Ascorbic acid (mg/100 g fruit)	61.80	81.19	52.76	52.37	10.06	10.03	99.3	26.37

be 28.10 and 27.61, respectively. The heritability value was noted be 97.0% and expected genetic advance was 4.68%. The T.S.S. varied between 5.06 to 12.03% with general mean 8.54%.

The phenotypic coefficient of variation was 25.90 and genotypic coefficient of variation was 25.78. The heritability value was recorded to be 99.0%. The expected genetic advance was recorded to be 5.28 %.The data of experiment showed that the titrable acidity ranged from 0.57 to 0.75% with a general mean was 0.66%. Phenotypic and genotypic variation for this trait were 12.25 to 11.98, respectively. The heritability value for this trait was 96.5%. The value of expected genetic advance was noted to be 0.19%.The data recorded reveals that the ascorbic acid content varied from 61.8 to 81.19 mg with a general mean of 71.49 mg. Phenotypic coefficient of variation was 10.06 and genotypic coefficient of variation was 10.03 for this trait. The heritability value was 99.0% and the expected genetic advance was 19.03%. Findings of present study are in line of Das (2), Lal and Seth (3) and Sharma *et al.* (4).

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Research Note :

RESPONSE OF BORON, ZINC AND COPPER ON QUALITY OF AONLA FRUITS CV. BANARASI

Prakash Chandra Singh, Ritesh Singh Gangwar and Vivek Kumar Singh

College of Agriculture, C.S.Azad University of Agriculture and Technology, Kanpur–208 002 (U.P.)

Keywords : *Zinc, boron, copper, quality, aonla.*

Aonla (*Emblica officinalis* Gaertn) belongs to family Euphorbiaceae and is popular as backyard fruit through out the country. Owing to its hardy nature, suitability to waste land, high productivity, high nutritive and therapeutic value, it became an important fruit. The fruits are highly nutritive and rich source of ascorbic acid. Fruits are commonly used for preparation of preserve, pickles, jelly, sauce and dry chips etc.There is no relevant information on the effect of zinc, boron and copper on fruit quality of aonla. Thus considering the importance of boron, zinc and copper in influencing the fruit quality, present investigation was undertaken.

The present investigation was carried out on aonla cultivar Banarasi in a R.B.D with three replications in the Horticultural Garden of Department of Horticulture, C.S.A.U.A.&T., Kanpur during two consecutive years of 2006 and 2007, respectively. There were ten treatments comprising three levels each of boron (0.1%, 0.2%, and 0.3%), zinc (0.2%, 0.4% and 0.6%) and copper (0.1%, 0.2% and 0.3%) along with a control. The quality parameters of aonla fruits viz. T.S.S. of fruit, acidity, total sugars, reducing sugars, non-reducing sugars and ascorbic acid content were estimated as per standard procedures.

The T.S.S. content of aonla fruits was improved significantly with the foliar-feeding of all the three micro-elements. However, the maximum improvement was noticed under zinc (13.07 and 13.11°brix) during both the years. On increasing the concentration of all the three elements, improvement in T.S.S. content of aonla fruits was noted. Zinc at higher concentration proved most effective in enhancing it (12.91 and 12.95°brix). Zinc in the present experiment might have proved helpful in the process of photosynthesis and active translocation in fruits. It might have regulated the enzymatic activities which ultimately promoted the fruit quality. Similar results were also found by Panwar *et al.* (4).

The acidity content of aonla fruits was significantly reduced by increasing the concentration of minerals and the maximum reduction in this regard (2.25 and 2.24%) was obtained at higher concentration. As high as 9.01% and 6.95 % reduction in acidity content were recorded in respective treated tree as compared to control in respective year of trial. The reduction in acidity might be attributed to increase in the level of nutrients in various plant parts particularly the fruits which could have played beneficial role in improving the fruit quality (Babu and Singh, 1).

Both foliar spray of micro-element and their levels when examined individually, influence the sugar content significantly in aonla fruit. The higher values of total sugar were recorded under foliar spray of zinc (9.36 and 9.30) and it higher concentration (9.26 and 9.21%) the interaction of micro element and their concentrations were found ineffective in altering the sugar content of aonla fruits.

The significant improvement in reducing sugar was noticed by applying micro nutrients and the fruits of treated trees showed contain 18.99% and 15.44% more reducing sugar as compared to control. Among the three micro nutrients zinc proved more beneficial expressing (5.17 and 5.15 %) content in respective year of study. The effect of concatenations was significant only in second year of fruiting where the higher concentration enhanced reducing sugar content to the time of 5.05%.

The non-reducing sugar content of aonla fruits was significantly influenced by application of

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Table 1: Effect of B, Zn,Cu and their concentrations on chemical characteristics of aonla fruits.

T.S.S. (°B)

Treatments	Minerals				Minerals			
	Boron	**Zinc**	**Copper**	**Mean**	**Boron**	**Zinc**	**Copper**	**Mean**
	2006				**2007**			
Low	12.19	12.98	11.56	12.24	12.21	13.03	11.62	12.29
Medium	12.31	13.07	11.94	12.44	12.35	13.12	12.03	12.50
High	13.00	13.17	12.57	12.91	13.01	13.19	12.64	12.95
Mean	12.05	13.07	12.02		12.52	13.11	12.10	
Control				11.32				11.54
Treated				12.53				12.58
C.D. (P = 0.05)	M	C	MxC	Tr × Cont.	M	C	MxC	Tr × Cont.
	0.13	0.13	0.23	0.17	0.13	0.13	0.22	0.16

Acidity (%)

Low	2.39	2.22	2.51	2.37	2.36	2.18	2.48	2.34
Medium	2.34	2.17	2.47	2.33	2.32	2.13	2.40	2.28
High	2.26	2.08	2.43	2.25	2.29	2.05	2.39	2.24
Mean	2.33	2.16	2.47		2.32	2.12	2.42	
Control				2.55				2.46
Treated				2.32				2.29
C.D. (P = 0.05)	M	C	MxC	Tr × C	M	C	MxC	Tr × C
	NS	0.13	NS	0.48	NS	0.11	NS	0.14

Total sugar (%)

Low	8.92	9.18	8.74	8.95	8.83	9.15	8.62	8.87
Medium	9.01	9.32	8.85	9.06	8.97	9.30	8.73	9.00
High	9.15	9.59	9.05	9.26	9.18	9.46	9.00	9.21
Mean	9.03	9.36	8.88		8.99	9.30	8.78	
Control				8.05				7.98
Treated				9.09				9.03
C.D. (P = 0.05)	M	C	MxC	Tr × C	M	C	MxC	Tr × C
	0.14	0.14	NS	0.02	0.22	0.22	NS	0.32

Reducing sugar (%)

Low	4.93	5.15	4.84	4.97	4.75	5.05	4.56	4.79
Medium	4.95	5.14	4.93	5.01	4.82	5.13	4.63	4.76
High	5.03	5.23	4.98	5.08	5.00	5.26	4.88	5.05
Mean	4.97	5.17	4.92		4.86	5.15	4.59	
Control				4.37				4.21
Treated				5.20				4.86
C.D. (P = 0.05)	M	C	MxC	Tr × C	M	C	MxC	Tr × C
	0.09	NS	NS	0.12	0.14	0.14	NS	0.18

Non-reducing sugar (%)

Low	3.78	3.82	3.71	3.77	3.87	3.90	3.85	3.86
Medium	3.85	3.99	3.72	3.85	3.94	3.96	3.89	3.93
High	3.92	4.14	3.86	3.97	3.97	4.00	3.91	3.96
Mean	3.85	3.98	3.76		3.93	3.95	3.88	
Control				3.50				3.58
Treated				3.87				3.92
C.D. (P = 0.05)	M	C	MxC	Tr × C	M	C	MxC	Tr × C
	0.09	0.09	NS	0.12	NS	NS	NS	0.13

Ascorbic acid (mg/100 g pulp)

Low	603.33	620.21	586.97	603.49	606.15	623.46	590.74	606.78
Medium	608.97	625.88	593.35	609.40	610.72	628.58	595.75	611.68
High	615.43	645.66	608.77	623.29	618.39	646.76	641.33	635.49
Mean	609.24	630.57	596.36		611.75	632.93	609.27	
Control				579.57				581.92
Treated				612.06				617.99
C.D. (P = 0.05)	M	C	MxC	Tr × C.	M	C	MxC	Tr × C
	6.47	6.47	NS	8.36	8.75	8.75	15.16	11.30

minerals and their concentrations in the previous year of study and zinc (3.98%) and higher concentration (3.97%) caused the maximum improvement of in this quality trait. The interaction between minerals and their concentrations failed to exert any significant influence in this regard. The increase in above attributes could be explained by the fact that zinc and boron sprays being highly helpful in the process of photosynthesis which laid to accumulation of carbohydrate which ultimately improved the fruits quality.

Among micro-nutrients, zinc proved significantly superior (6.30.57 and 632.93 mg/100 g pulp) than boron and copper in improving the ascorbic acid content of aonla fruits. Increasing concentrations of minerals enhanced the vitamin C content and maximum improvement was registered at higher concentration (623.29 and 635.49 mg/100 g pulp). The interaction effect of minerals and their concentrations was not significant in the previous year, however, in the second year zinc at 0.6% spray induced maximum amount of ascorbic acid (646.76 mg/ 100 g pulp) in aonla fruits. The increase in ascorbic acid content might be due to the fact that zinc works as a stimulant for amino acid synthesis and helps in the process of photosynthesis. The present finding are in conformity with earlier reports of Dutta *et al.* (3) and Chaturvedi *et al.* (2).

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Research Note :

SCREENING OF OKRA VARIETIES FOR RESISTANCE TO YELLOW VEIN MOSAIC VIRUS UNDER FIELD CONDITION

Ajay Tiwari, B. Singh, T.B. Singh, S.K. Sanval and S.D. Pandey

Indian Institute of Vegetable Research, Varanasi

Keywords : *Varieties, screening, YVMV, Okra.*

Okra or Bhindi [*Abelmoschus esculentus* (L.) Moench] is an annual, herbaceous, plant of erect growth habit, with or without branches and with bisexual flower, which belongs to family Malvacene. It is one of the most popular vegetable crops cultivated throughout world. Because of high consumer demand and thereby better price, farmers grow okra widely during the rainy and summer season. The crop is very much susceptible to whitefly (*Bemisia tabaci Gen*.) transmitted yellow vein mosaic virus. It is the most destructive disease, which causes heavy yield losses in the crop by affecting the quality and yield of fruits. Some attempts had been made by several workers to reduce to disease through the vector control (Bhagal *et. al.* 3; Chakraborty and Mukhotadhyay, 4; Shastry and Singh, 8; Singh and Singh, 9), resistant screening (Arora *et. al.* 1; Singh and Singh, 10) and also through the breeding strategies (Jambhale and Nerkar, 5; Nerkar and Jambhale, 7). Emphasis is needed on breeding to develop yellow vein mosaic virus resistant variety. This study was undertaken to find out the potential source of resistance of okra to yellow vein mosaic virus under natural epiphytic condition.

The experiment was conducted at the Indian Institute of Vegetable Research, Varanasi during 2006 and 2007. Seeds were sown in single 5m row with 20 cm plant and 45 cm row spacing. The experiment was carried out in randomized block design. All the recommended agronomic practices were adopted. For assessing the yellow vein mosaic virus in okra varieties, the intensity of the yellow vein mosaic disease was calculated according to method suggested by Banarjee and Kalloo (2) as per given in Table 1.

Table 1 : Scale for classifying disease reaction of Okra to yellow vein mosaic virus.

YVMV Symptoms	Severity Grade	Reaction
Symptoms absent	0	Highly Resistant
Very mild symptoms up to 25% plant	1	Resistant
Appearance of symptoms in 26-50% plant	2	Moderately Resistant
Appearance of symptoms in 51-75% plant	3	Moderately Susceptible
Sever disease infection in symptoms (>75% plant)	4	Highly Susceptible

In 2006 and 2007 incidence was recorded 90 days after sowing. The per cent disease incidence (PDI) was calculated by the formula :

$$PDI = \frac{\text{Number of diseased plant}}{\text{Total no. plant observed}} \quad 100$$

Rainy season 2006 : Five varieties of okra were screened for resistance to infection by YVMV of okra under field condition. It was found that only one variety *i.e.,* VRO-6 was found to be resistant to yellow vein mosaic virus disease (Table 2). Beside that moderately resistance was obtained in two varieties in VRO-3 and HRB-9-2. These varieties showed per cent disease intensity of 31.3 to 35.5 under field condition. The other variety Pusa Sawani showed high susceptibility to this disease and per cent disease incidence was 90.2. In other variety Pusa Makhamali, disease reaction was found moderately susceptible with per cent disease incidence of 53.2 under field condition.

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Table 2: Screening of okra varieties for YVMV intenstity in 2006.

Variety	Severity Grade	Per cent Disease Intensity	Reaction
Pusa Sawani	4	90.2	Highly susceptible
VRO-3	2	31.3	Moderately resistant
Pusa Makhamali	3	53.2	Moderately susceptible
VRO-6	1	15.5	Resistant
HRB-9-2	2	35.5	Moderately resistant

Table 3: Screening of okra varieties for YVMV intenstity in 2007.

Variety	Severity Grade	Per cent Disease Intensity	Reaction
HRB-9-2	2	37.5	Moderately resistant
VRO-3	2	29.5	Moderately resistant
VRO-6	1	13.5	Resistant
Pusa Makhamali	3	55.1	Moderately susceptible
Pusa Sawani	4	92.3	Highly susceptible

Rainy season-2007

It was found that two varieties *i.e.,* VRO-3 and HRB 9.2 were found to be moderately resistant with 29.5 to 37.5 per cent disease intensity (Table 3). Besides that high degree of resistance was obtained in variety VRO-6 under field condition. This variety showed per cent disease intensity of 13.5. The rest two varieties *i.e.,* Pusa Makhamali and Pusa Sawani showed moderate susceptible and highly susceptible reaction respectively. Pusa Sawani showed 92.3 per cent disease intensity.

Results of this study indicated that VRO-6 and VRO-3 were found to be most promising variety against yellow vein mosaic infestation in the field. This could be a useful source of resistant genes to yellow vein mosaic virus. Similar type of works has been reported by (Khan and Mukhopadhyay, 6) in screening of okra varieties to yellow vein mosaic virus.

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Research Note :

PARTICIPATION OF FARM WOMEN IN AGRI-HORTICULTURAL ACTIVITIES IN RURAL AREA OF DELHI

Manoj Kumar Pandey[1] and Himanshu Pandey
Krishi Vigyan Kendra, Ujwa, New Delhi-110 073
[1]K.V.K., Deoria

Keywords : *Farm women, socio-economic profile, drudgery reduction.*

Delhi is National Capital Teritory and one of the biggest metropolitan city of our country. Soil of Delhi is sandy loam type and ground water mostly brackish. Due to dense population, vegetable demand is high but most of the farm women have small and marginal land holding. Farm women contribute significantly to agriculture and allied activities in the Delhi. They expend their energies in growing marginal crops from marginal lands with marginal resources. Various studies conducted in our country indicated that farm women contributed in all activities except ploughing, they are involved in all other activities in some form or the other. The present study was conducted to analyze the extent of participation of farm women in wheat, mustard, paddy and horticultural crops grown in rural peripheri of Delhi.

The study was carried out in two blocks of rural Delhi *i.e.* Najafgarh and Alipur which have cultivated land in NCT Delhi, where women participate in agriculture. A sample of 238 farm women representing small, medium and large farm families was selected from 4 villages of each block. A list of major operations to be performed in the wheat, mustard, paddy and vegetable crops was prepared and the farm women were asked to indicate the extent of participation in terms of self-participation, assistance and no participation. A score of 2, 1 and 0 was accorded to each category of participation. Based on the mean and standard deviation, the farm women were grouped as having "High", "Medium" and "Low" participation.

Socio-economic profile of respondents

The socio-economic profile of the farm women indicated that majority of them belonged to 26-52 years age group, had a family size ranging between 4-7 members and had about 15 years of experience in agri-horticulture related activities and their annual income ranged between Rs. 50,000 to Rs. 1,10,000. Among respondents 40% stated they had no media contact with extension agencies, 55% of them had no media exposure and 45% of them had low awareness about state development programmes. The psychological characteristics indicated low to medium level of achievement motivation, medium creativity and low to medium rationality in decision making.

Table 1: Participation of farm women in different activities of farming.

Activity/ Crop	Wheat	Mustard	Paddy	Horti-cultural crops
Ploughing	0	0	0	0
Seed treatment	2	1	1	1
Sowing/transpl-anting	0	2	2	2
Irrigation	2	2	1	2
Weeding	2	1	2	2
Harvesting	2	2	2	2
Threshing	2	2	2	-
Winnowing	2	2	2	-
Post harvest operations	2	2	2	2
Marketing	0	0	0	0

Participation in farm activities

The findings of the study revealed that majority of the farm women had medium to high participation in wheat production activities. Self participation was found in seed treatment, irrigation, weeding, harvesting, threshing, winnowing, drying and storage. They did not perform sowing, ploughing, marketing and maintenance of agricultural implements. Mustard is grown in this area for oil purpose and its cake for animal feed. The participation of farm women was found to be high in sowing, irrigation, harvesting

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and threshing. Moreover, post harvest operations were the exclusive domain of farm women irrespective of the farm size. Manju (2), Goyal *et al.* (1) and Waris (3) reported high participation of women in weeding, harvesting, threshing and post harvest operations. While in case of paddy participation of farm women was found high in transplanting, weeding, harvesting, threshing and drying/storage.

Similar to wheat, in mustard and paddy, participation of farm women was found high in sowing/transplanting, weeding, irrigation, harvesting, grading and packaging of horticultural crops. Participation in terms of assistance was found to be more in activities such as fertilizer application, seed & seedling treatment and spraying of pesticides. It was observed that though the farm women perform all major activities, marketing was not their domain. The reason for non participation in marketing may be social restriction on their mobility. Similar finding of high participation rate of women in weeding, drying and storage have been reported by Goyal *et al*. (1) and Waris (3).

Conclusion

Farm women participation to agri-horticulture in rural Delhi is immense and based on the findings of the study it can be concluded that except ploughing they are involved in all other activities in some form or the other. It was observed that majority of farm women belong to the 26-52 years age group, the extension personnel may therefore, concentrate on technology transfer to this age group for quick dissemination and wide spread adaptation of improved and drudgery reduction technologies. It is also realize that rural farm women can work through local women's group and reach home bound women whose access to services and resources is restricted.

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Book-Review

Encyclopedic Dictionary of Agriculture

by Dr. Anil Kumar Singh

Jain Brothers, New Delhi, 2012,
Rs. 425/- Student edition, Rs. 800/- Library edition,
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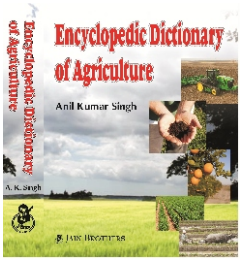

Agriculture is a vast subject directed to nutritional security and environmental conservation in the nation, and it is gaining importance for increasing agricultural productivity and foreign trade. We are running in the era of competition where competitive examinations have become a regular feature at every stage from seeking admissions to securing a good placement. Sound knowledge of up-to-date vocabularies of modern agriculture is quite necessary for aspirants to take and surpass competitive examinations by the easiest way. Hence, the present book is the up-to-date compilation of most relevant terms, definitions, glossaries, idioms, quotations, proverb, meaning and phrases on modern agriculture as a whole in a capsulated form. The book is one of the unique, modern, authentic and exhaustive collection of agricultural terms well defined with examples. An encyclopaedic approach to define terms with idioms, quotations and phrases provides a little more authentic information apart from the definition or explanation of agricultural terms. It aims at helping the students in getting admission in higher classes, fellowships and to clear one or other competitive examination for securing good placement after studies. Academicians, teachers, scientists, professionals, entrepreneurs as well as farmers can also update themselves with new and upcoming terms, definitions and important techniques capsulated in this '*Dictionary*'. It is immensely valuable for students, researchers, academicians and subject experts of agriculture and allied plant sciences in pursuits of their academic goals, competitive examinations and interviews. All the persons directly or indirectly related to agriculture will like to keep this book on their shelves.

Fundamentals of Ornamental Horticulture and Landscape Gardening

by Dr. A. K. Tiwari

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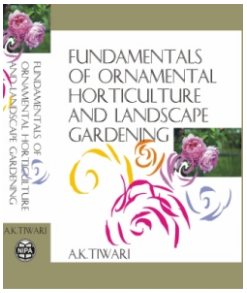
Rs. 2000/- ISBN:978-93-81450-07-9, 548 p.



Ornamental plants comprise of so many type of plants-seasonal flowers, perennials, succulents, cacti, climbers, shrubs, cycads, palms, trees etc., having annual or perennial nature with much variations in forms of their beautiful parts-flower, calyx, foliage, or as a whole. The present book "***Fundamentals of Ornamental Horticulture and Landscape Gardening***" covers all the above facets very nicely in simple and understandable language and manner. Compilation of authentic information, which is in scattered form in different books, on all aspects of ornamental gardening is very hard task. Students at UG, PG, Researchers, landscapers and scientists as well as gardening amateurs are needy to this type of manuscript in a capsulated and easy to handle form of book. The first and second chapters on "Garden Tools & Implements" and "Classification & Identification of Ornamental Plants" containing very impressive illustrations fulfils the basic need of students and landscapers as well as gardeners to be acquaintance with them in simple way. Cultivation and Management of various plants as well as their nutrition and weed management in separate chapters is a very sincere effort to fulfil the course content requirements of students and landscapers. Role of PGRs in ornamental horticulture has been described very systematically with their responses in different physiological aspects of plants which are very useful for course content for students of graduate to higher level classes. To fulfil the basics of fascination of indoor gardening, chapters on management of pot and indoor plants, bonsai making as well as floral arrangements have been written very effectively. Chapters on "Bio-aesthetic planning" and "Basics of Landscape Gardening" separately would be of the most useful text matter to students, landscapers and subject experts to adorn their career related to this fascinating branch of horticulture. Reference guide described at last but not least will be of very useful in identification and selection of perennial ornamental plants to landscapers as well as garden amateurs. More specifically, though it has great scope to incorporate new researches and colourful illustrations in next revised editions, it may be concluded that this book is one of the first endeavour to provide a lot of concerned matter of text in a capsulated and easy to handle form of book.

Dr. Vijai Kr. Umrao
Manading/Chief Editor
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3. Kapil R.N. and Arora S. (1990). Some fascinating features of orchid pollen. *J. Orchid Soc*., **4** (1): 9-28.
4. Rashid S., Ashraf M., Bibi S. and Anjum R. (2000). Antibacterial and antifungal activities of *Launaea nudicaulis* Roxb. and *Launaea resedifolia* L. *Pakistan J. Biol. Sci*., **3** (4) :630-632.

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